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OSSIFICATION (SO-CALLED "CALCIFICATION") OF NORMAL LARYNGEAL CARTILAGES MISTAKEN FOR FOREIGN BODY

A CORRELATION OF ROENTGEN AND HISTOLOGIC FINDINGS*

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ROENTGENOGRAMS of the neck frequently reveal shadows due to deposits of calcium in normal laryngeal cartilages. Before entering upon a discussion of the possibility of these shadows being mistaken for foreign bodies in the food passage, certain anatomic and histologic facts should be reviewed.

In some tissues and organs calcium deposits are the result of degenerative changes. To these deposits the term "calcification" is applicable, for they have none of the structural characteristics of bone. Calcium deposits in the laryngeal cartilages produce much the same roentgen appearance, and are consequently often referred to by the roentgenologist as "calcification." We fell into this error until our attention was called to their true osseous nature by Dr. O. V. Batson of Philadelphia.

Practically all of the standard textbooks on anatomy and histology, including Bremer,[1] Jordan,[2] Piersol,[3] Maximow,[4] and Cunningham,[5] point out that ossification starts in certain cartilages of the larynx as early as the twentieth year. All of the original work on the subject has resulted in this conclusion: that actual bone formation takes place before full maturity is reached. Chievitz[6] states it exceptionally well by saying that ossification begins normally when skeletal growth is otherwise complete. Bone formation occurs in the male as early as the age of twenty, but is rarely seen in the female before the twenty-second year. The only exception to this statement is found in Fraenkel's[7] work. He found ossification in the thyroid cartilage in individuals under twenty in 11 out of 101 cases. He found ossification in the female as early as the age of fifteen, in males of eighteen and nineteen.

The cartilages of the larynx that ossify are of the hyaline variety. In this group belong the thyroid, cricoid and the greater part of the arytenoids. In some cases, according to Bremer, the small triticeous cartilages (small nodules in lateral hyothyroid ligament) are hyaline and become ossified, although these structures are usually composed of fibrocartilage.

The median portion of the thyroid cartilage is made up of the elastic variety of cartilage which seldom ossifies. Occasionally bony nuclei are seen in this region but they are spaced far apart. The apices or tips and the vocal processes of the aryte-

* Read before the Section on Radiology of the American Medical Association, Cleveland, Ohio, June 14, 1934.

Fig. 1. Section of thyroid cartilage showing true bone.

noid, the corniculates (of Santorini), and cuneiforms (of Wrisberg) and the epiglottis, are composed of the elastic variety of cartilages. These cartilages may become infiltrated with fat but are not subject to ossification. There is one case on record in which ossification was found in the corniculate cartilages. This was a female aged one hundred and two. The case was reported by Scheier in 1910.[8]

There has been a considerable amount of original work done on the subject of ossification of the laryngeal cartilages but there is a dearth of material on the subject in the English literature. In 1882 Chievitz published his observations after a thorough histologic survey of the laryngeal cartilages in 270 cases. The information on this subject furnished in our present-day textbooks is the same as noted by this author. His report as to the age at which bone is first seen in the cartilages of the male and female, difference in degree of bone formation, and the type of ossification, has been substantiated by many investigators.

Twenty years later (1902) Scheier made a very profound study of this subject. He made not only a histologic investigation, but also studied the removed cartilages by means of the roentgen rays. As far as we have been able to learn, he was the first one to use the roentgen ray to determine the extent and variety of sites of bone formation. His series consisted of 120 cases, of which 65 were males, and 55 were females. It is interesting to note that he predicted, thirty-two years ago, that incomplete ossification would be confused with foreign bodies on the roentgenograms.

Iglauer,[9] in 1914, emphasized roentgen examination of the larynx to study the normal process of ossification. The primary sites of bone formation in the cartilages were pointed out, as were the order in which the cartilages ossify.

In recent years several good articles have appeared in the literature. In 1926 Waldeyer[10] published a splendid anatomic treatise on the subject. He compared the difference in the degree and extent of bone formation in the cartilages of different races and included a study of the apes. One hundred and thirteen references are supplied in his bibliography.

In 1931 two articles were published on this subject. Henckel[11] made a study of the pattern of the bone formation and attempted to correlate it with the function of the cartilages. The same year Sayama[12] published the results of his work. He studied the cartilages of 50 male Chinese roentgenologically and histologically. Each cartilage was carefully roentgenographed so that the location of the bone in the cartilage and the degree of ossification were clearly demonstrated.

Ossification in the cartilages is considered to be chiefly an endochondral process. Chievitz states that the perichondrium plays only an insignificant part, and then only when the endochondral ossified portion of the cartilage has reached the surface.

Ossification starts from bony nuclei in the cartilage and spreads or radiates out until it joins other finger-like processes of bone which have started from neighboring centers. Bone formation is first seen in the caudal dorsal portions of the laminae of the thyroid. From this point it continues cephalad along the dorsal border, and ventrad along the inferior border. At the same time nuclei are seen in superior and inferior cornua.

To demonstrate bone formation in cartilages of the larynx histologically specimens were obtained from the autopsy room. The cartilages were decalcified, sectioned and prepared by Dr. W. C. Pritchard, Professor of Histology at Temple University Medical School.

Figures 1, 2, 3 are photomicrographs of sections of the thyroid, cricoid and arytenoid cartilages. The thyroid and cricoid show evidence of true bone but only

Fig. 2. Section of cricoid cartilage showing true bone formation.

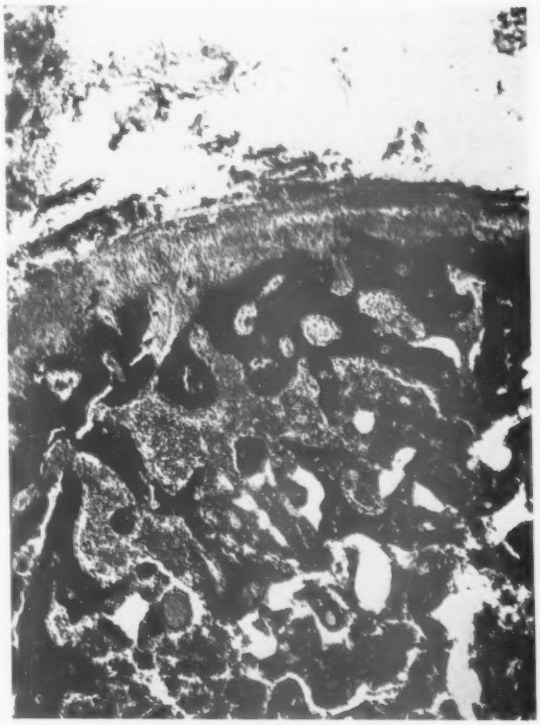

Fig. 3. Section of arytenoid cartilage showing osteoid tissue.

osteoid tissue is seen in the section of the arytenoid cartilage.

The laryngeal cartilages that become ossified are situated in close proximity to that portion of the hypopharynx through which food passes. It is therefore easy to understand how a partially ossified cartilage might be mistaken for a bony foreign body. It is rather the exception to have a sufficient content of bone in the cartilages to visualize them completely. The degree of ossification of the cartilages is not very closely correlated with the age of the adult patient. One is unable to predict the degree of bone formation, as it varies greatly.

Figure 4 compares a diagram of the larynx with a roentgenogram of a case in which the cartilages are fairly completely visualized by ossification. In such a case, interpretation presents little difficulty. More frequently the lateral roentgenogram of the adult neck reveals isolated, linear zones of calcific density in the dorsal extremities of the laminae of the thyroid,

the superior and inferior cornua of the thyroid, and the dorsal portion of the cricoid cartilage. These portions of the cartilages jut out into the soft tissue space of the pharynx and hypopharynx and, since a sliver-like area of bone in such a location appears to be isolated (because neighboring portions of the cartilage are

Fig. 4. Comparison of diagram from anatomy textbook with case showing marked ossification of the cartilages. Notice that the inferior border of the cricoid and superior border of thyroid cartilages are not ossified even though bone formation is extensive in this case.

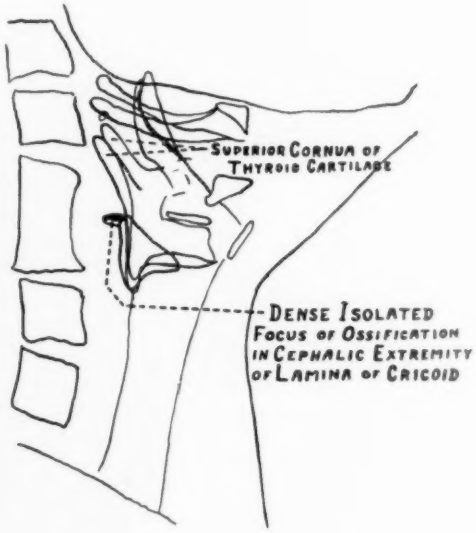
Superior Cornua of Thyroid Cartilage
Dense Isolated Focus of Ossification in Cephalic Extremity of Lamina of Cricoid

Fig. 5. Dense plaque of bone in cephalic tip of lamina of cricoid. This area of ossification was erroneously diagnosed a foreign body.

not yet ossified), it looks like a bony foreign body.

Our interest in this subject was stimulated by actual mistakes of this sort. The error is made more frequently when diagnosis is attempted on films of inferior technical quality. In our experience, a foreign body has not been overlooked because the roentgenologist considered it a normal structure, but an incompletely ossified portion of a normal cartilage has been diagnosed foreign body on a number of occasions. This erroneous diagnosis results in needless endoscopic examinations with trauma to the tissues. The failure to find a foreign body causes mental anguish to the patient and endoscopist.

Roentgenograms which demonstrate these confusing isolated bony plaques at various levels in the dorsal portions of the cartilages have been chosen for illustrations.

Figure 5 illustrates a confusing but not uncommon type of more or less isolated ossification in the cephalic margin of the lamina of the cricoid. In this particular case, these osseous shadows were interpreted as "foreign body" by a number of physicians, including roentgenologists, and several endoscopies were performed. The patient's subjective symptoms of "something sticking" were alleviated as soon as she was definitely assured that the shadow on the roentgenogram represented a perfectly normal structure.

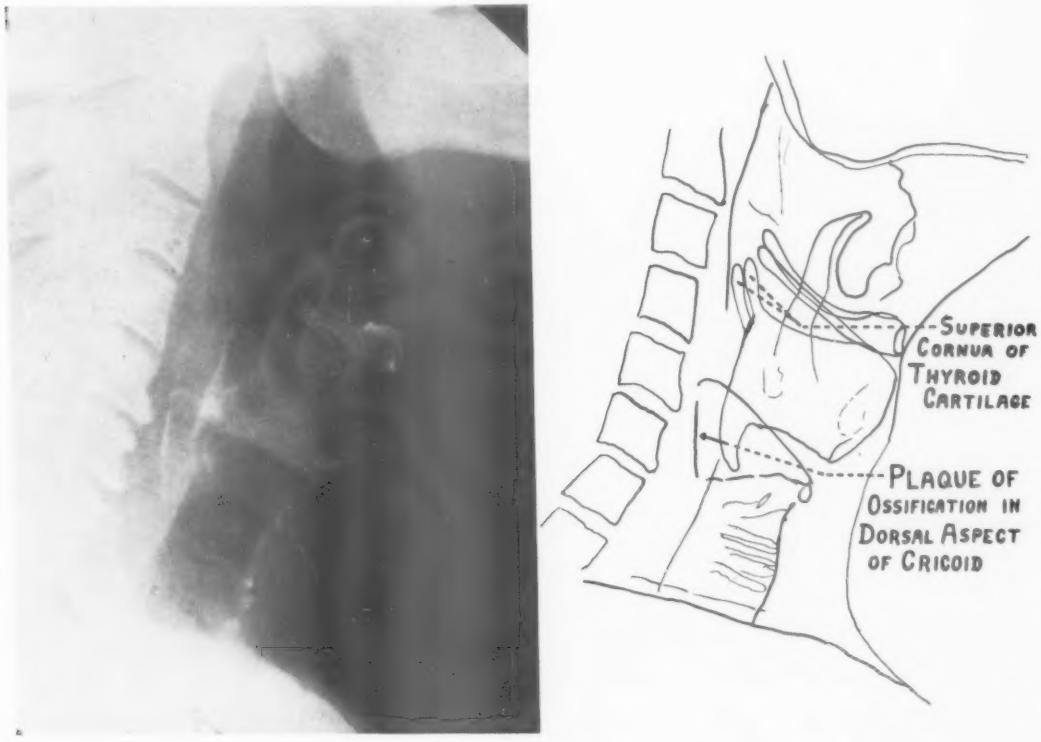

Fig. 6. Linear vertical shadow in dorsal aspect of signet of lamina of cricoid. Notice similarity to bony foreign body.

Occasionally a thin sliver-like zone of ossified cartilage is seen running in the vertical plane, the length of the dorsal aspect of the lamina of the cricoid. This linear shadow has been interpreted as a piece of chicken bone on several occasions. Figures 6 and 7 demonstrate such shadows clearly. Case VII had a definite history of swallowing a chicken bone. Endoscopic ex-

aminations failed to reveal a foreign body.

Infrequently, irregular ossification in the superior cornua of the thyroid cartilage simulates a foreign body. At times irregular bone formation in this region does not bear any resemblance to the normal, well-ossified structure, yet it is entirely within normal limits. Figures 8 and 9 show such peculiar depositions of bone, but careful endoscopic examinations revealed nothing abnormal in the pharynx, hypopharynx or esophagus of these patients.

It is rather uncommon to have a foreign body simulated by a fleck of ossified material in the inferior cornu of the thyroid cartilage but occasionally such a confusing appearance is seen. Figure 10 demonstrates such an appearance.

A word might be said regarding arytenoid ossifications which are frequently present and are usually incomplete. Figure 11 shows dense accumulations of bone in these structures. The widespread ossifications in the other cartilages and the complete visualization of the laryngeal ventricle in this case led us to include it for its anatomic interest. We do not believe that such a case involves any difficulty from the standpoint of differential diagnosis from foreign body.

Jönsson[13] has described a method of roentgen examination of the neck based upon inflation of the passages with air. At the moment of exposing the roentgenogram, the patient has inflated the hypopharynx, larynx, pharynx and other communicating spaces by the maneuver of forced expiration against closed lips and pinched nostrils, as in the Valsalva experiment. This maneuver may aid in differentiating foreign bodies from normal ossifications by improving detail and producing significant changes of relationships.

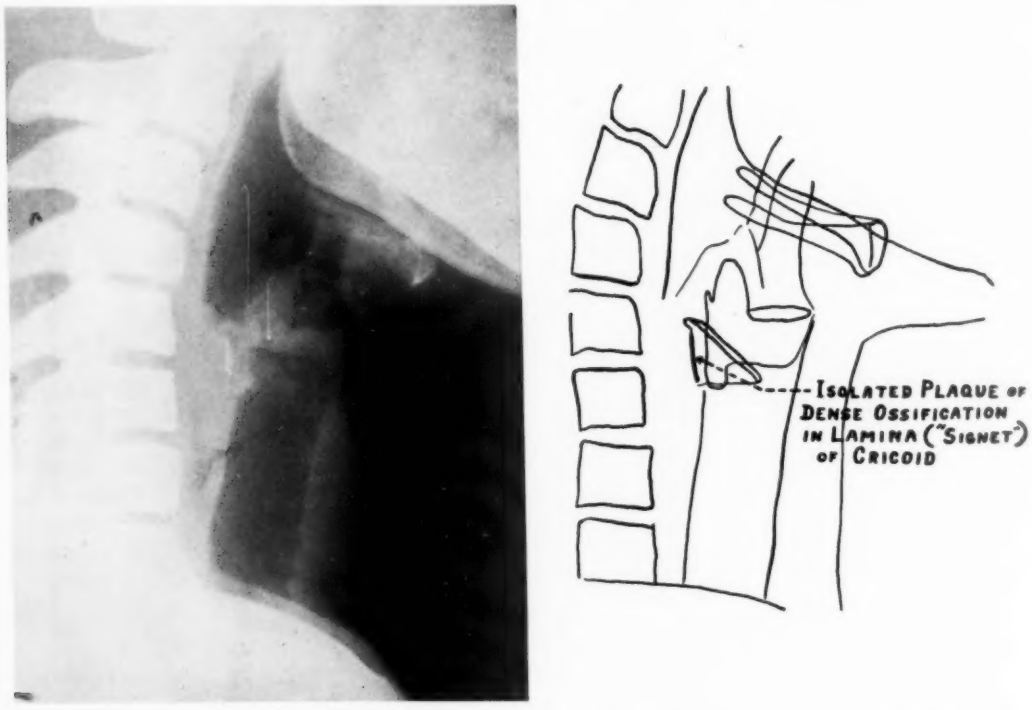

Fig. 7. Same type of shadow as seen in Figure 6. This patient had a definite history of swallowing a chicken bone, but endoscopic examinations revealed no foreign body.

SUMMARY

The zones of density in laryngeal cartilages which are frequently seen in roentgenograms of the neck are due to true bone,

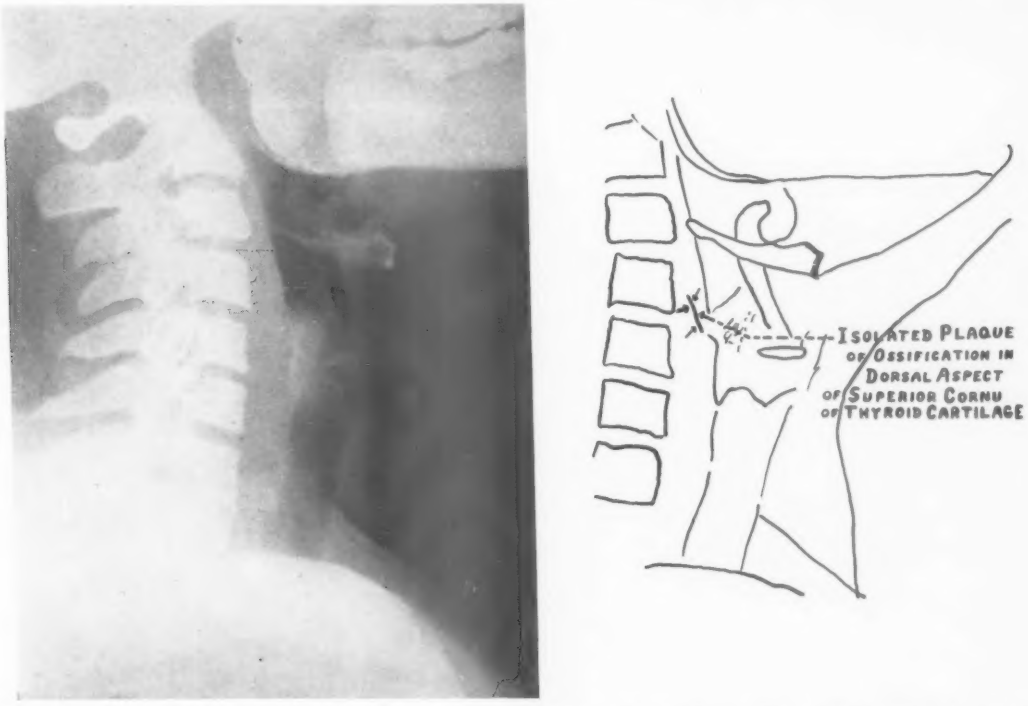

Fig. 8. Peculiar depositions of bone in superior cornu of thyroid cartilage. History of swallowing a chicken bone but careful endoscopic examinations revealed nothing abnormal in pharynx, hypopharynx or esophagus.

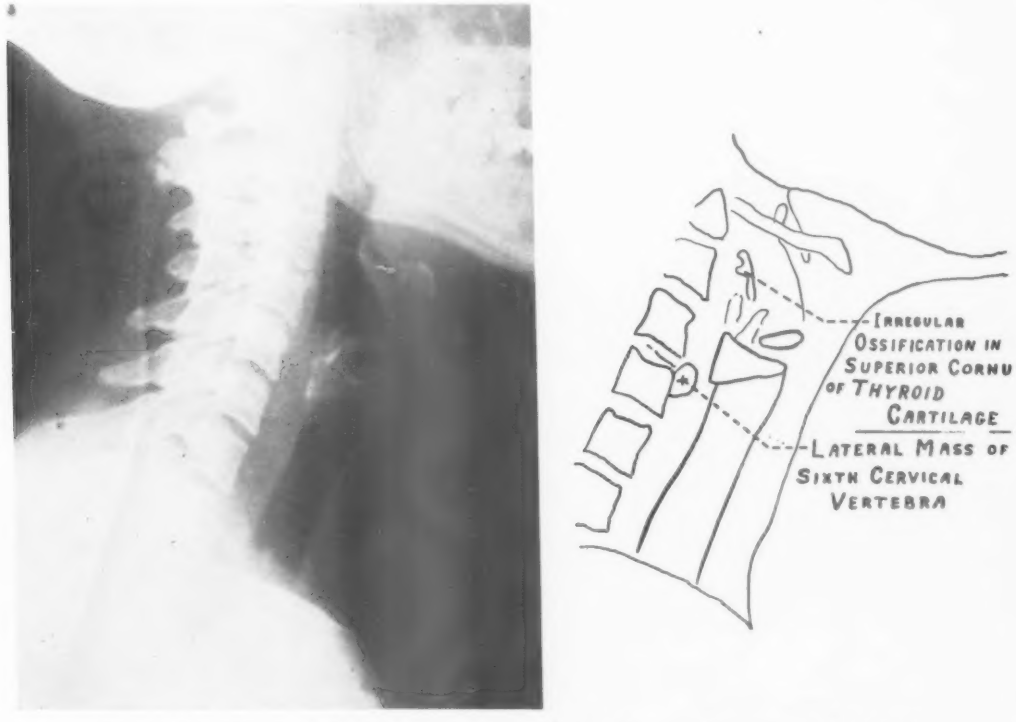

Fig. 9. Another variation of arrangement of bone in superior cornu of thyroid cartilage which simulates a foreign body.

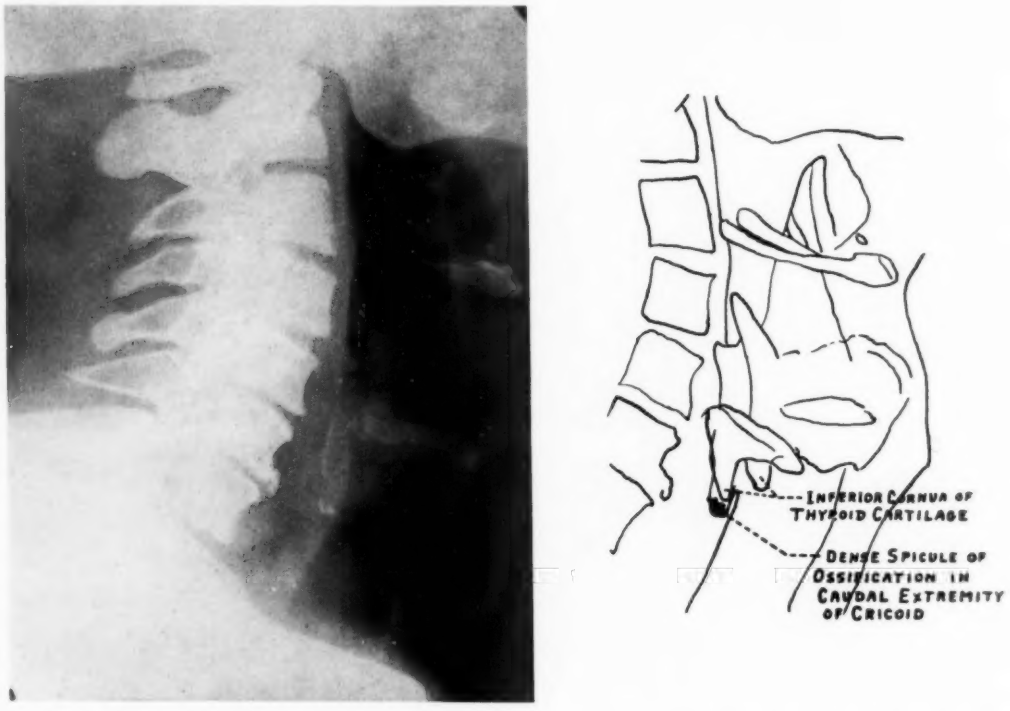

Fig. 10. Dense plaque of bone in inferior cornu of thyroid cartilage which appears to be a separate structure entirely, and therefore could easily be mistaken for a foreign body.

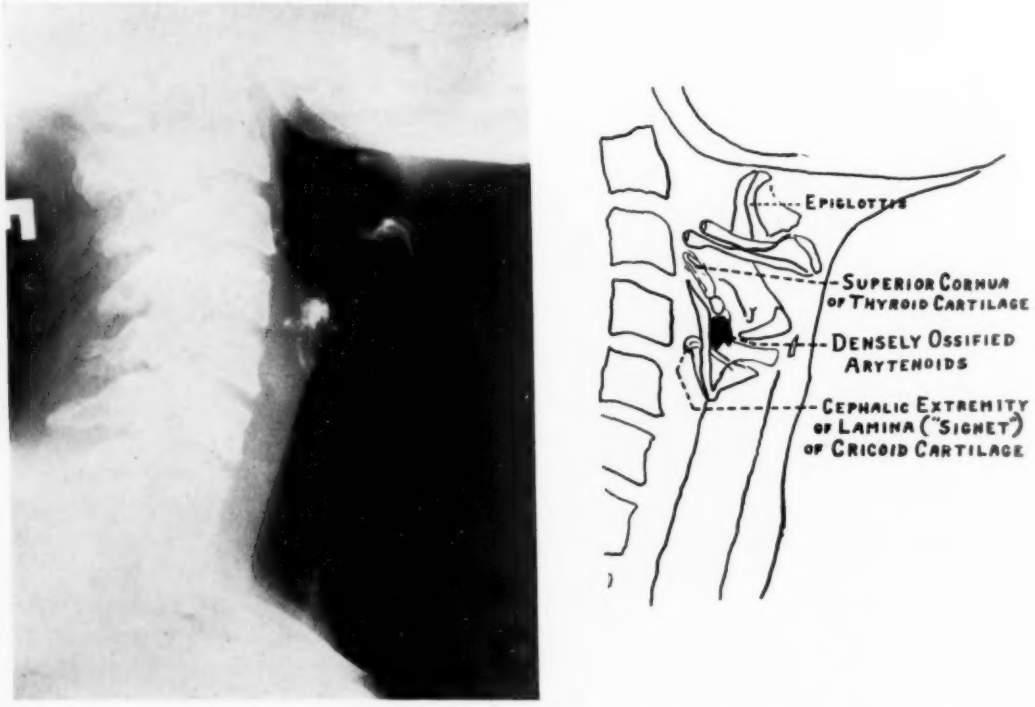
Epiglottis
Superior Cornua of Thyroid Cartilage
Densely Ossified Arytenoids
Cephalic Extremity of Lamina ("Signet") of Cricoid Cartilage

Fig. 11. Ossification in arytenoid cartilages. Usually these structures do not contain as much bone as is seen in this case. Laryngeal ventricle is well formed and easily visualized.

and should be designated as ossifications rather than calcifications. The present study presents histologic data to emphasize the osseous nature of the calcium deposits in the normal laryngeal cartilages. Those cases in which isolated ossifications have occurred in parts of the cartilages which are superposed upon the food passages, as seen in the lateral* roentgenogram, are of particular interest on account of the possibility of confusion with foreign body. That these osseous shadows may be mistaken for foreign body has been proved by actual occurrences.

* We have not been able to make use of the anteroposterior view as an aid in the differentiation of cartilage ossifications from foreign body because of the superimposition of the shadow of the cervical spine.

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DISCUSSION

Dr. Chevalier Jackson, Philadelphia. One by one I have seen done by roentgenologists the things they had said could not be done. This means they have surmounted difficulties, solved problems. This matter of ossification of the laryngeal cartilages, especially the cricoid, is of great importance because of chagrin to the roentgenologist and embarrassment for the bronchoscopist. Patients who have traveled hundreds of miles to have a bone removed are likely to be critical if told there is no bone there. Usually, but not always, the patient has a sensation as of something sticking in his throat when he swallows. This may be a bone, or trauma caused by the bone that has passed on, or it may be due to instrumentation or to efforts of members of the family to remove a bone that may or may not have been present. Sometimes there is a spicule of bone producing the symptoms, but it is not the cause of the shadow.

On the technical side, I have nothing to add to what has been said. I would suggest: (1) cross-filing all lateral films of the neck so that the filing clerk can get out many films for comparison; (2) one or more specimens of the cartilages of the larynx to assist in piecing out the patches of shadows to outline the cartilages in the films of the patient; (3) a very important point is to get the lower border of the cricoid cartilage. If there is a shadow below it or a negative shadow with barium, it is almost certainly a foreign body. Ninety-eight per cent of the foreign bodies in this region are below the lower border of the cartilage; that is, below the cricopharyngeus muscle; (4) look for pathologic

shadows due to sepsis or instrumentation; (5) if you find nothing and the patient has sensations advise esophagoscopy.

Dr. Samuel Brown, Cincinnati, Ohio. I would like to have Dr. Young say something about the technique used.

Dr. Young (closing). Two different techniques were used in making the roentgenograms. Most of them were made with the Rotalix tube (rotating anode) at a distance of 4 feet. We used from 60 to 65 kv. peak and 20 milliampere-seconds (400 ma. for 1/20 second). A few films were exposed at 7 feet using 33 milliampere-seconds (1000 ma. for 1/30 second) and 70 kv. peak.

We were diffident about presenting this subject since we felt that it might be considered elementary. I believe we shall adopt Dr. Jackson's suggestion of placing specimens of the laryngeal cartilages in the roentgen department viewing room, so that we may constantly refresh our memories as to their appearance, and compare them with shadows of osseous density which are seen on the roentgenogram. To date we have relied solely on our memory of the roentgen appearance of the normal neck as a standard of the normal, or have referred to textbooks of anatomy.

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FUSOSPIROCHETAL PNEUMONIA*

By CARLETON B. PEIRCE, A.B., M.S., M.D.
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THE importance of the fusospirochetal group of organisms in chronic lung disease, particularly pulmonary abscess and gangrene, has become increasingly apparent. While it has been appreciated that these end-states may be preceded by pneumonic involvement, fusospirochetal pneumonia has not been fully recognized. Our observations lead us to believe that it is comparatively common, with features which distinguish it as a clinical entity.

Clinical interest in the fusospirochetal group of organisms, as important factors in diseases of the bronchi and lungs is largely a development of the last decade. However, Leyden and Jaffe[21] in 1867 described closely wound, spiral organisms in the lung tissue and sputum of cases of "putrid bronchitis" and pulmonary gangrene. Their sketches show also bacillary forms of fusiform contour. *Leptothrix*, appearing with these, was recognized as a common mouth inhabitant. They had not seen spirochetes in saliva, but postulated that mouth organisms had gained access to the lung with resultant "decomposition."

The observations of Vincent from 1896[35,36] to 1899[37,38,39,40] on spirochetes and fusiform bacilli in "hospital gangrene," and angina of the pharynx are well known. Rona[30] in 1905 described spirochetes in the tissues of two cases of lung gangrene. Castellani[7] reported from Ceylon, in 1906, two cases of chronic respiratory infection with hemoptysis, each showing numerous spirochetal forms in the sputum but no acid-fast bacilli. He considered the spirochetes as secondary invaders in tuberculosis, but gave to the syndrome the name "bronchial spirochetosis." Castellani's report apparently gave the stimulus to more widespread interest as indicated by the subsequent increased frequency of reports of spirochetal organisms in disease of the lung, especially in the tropics. At first the concept was that of a bronchitis, and the terms "hemorrhagic bronchitis," "bronchial spirochetosis," or "bronchopulmonary spirochetosis" were applied. In most instances the clinical descriptions were meager, and roentgen studies lacking, so that it is impossible to fully evaluate the character of the reported lesions.

The first cases recognized in the United States (by Rothwell,[29] 1910) were called bronchial Vincent's angina.

The recent excellent studies in this country by Kline and associates,[16,17,18,19,20] Pilot and associates,[8,25,26,27] and Smith[31,32,33] have focused attention upon the rôle of the fusospirochetal group of organisms in lung abscess, pulmonary gangrene, bronchiectasis, and certain cases of unresolved pneumonia.

BACTERIOLOGY

The respiratory tract infections present a multiplicity of aerobic organisms, many of which are pyogenic, some of which are ordinarily non-pathogenic saprophytes, capable of pathogenicity under proper environmental situations.

Many observers since Vincent have found a multiplicity of aerobic organisms associated with the anaerobic spirochetes and fusiform bacilli in pulmonary disease, *Streptococcus viridans* and *Streptococcus haemolyticus* predominating.

The spirochetes are actively motile, gram-negative, fine or coarse, with four to ten turns, resembling in morphology *T. Vincenti* (Blanchard), *T. macrodentium* (Noguchi) and *T. microdentium* (Noguchi).[23] The fusiform bacilli are often barred and

* From the Departments of Roentgenology and Internal Medicine, Medical School, University of Michigan. Read at the Thirty-fifth Annual Meeting, American Roentgen Ray Society, Pittsburgh, Pa., Sept. 25–28, 1934.

slightly curved, some actively motile. Thread-like or mycelial-like, non-branching organisms may be present, about which the typical bacilli and spirochetes may be clustered. Short fusiform bodies, vibrios, and comma bacilli may appear. The organisms in general conform in morphology to those found about the teeth and in the tonsils. *B. influenzae*, *Leptothrix*, *B. capsulatus*, and *Micrococcus catarrhalis* have been reported in apparent symbiosis with the anaerobes.

Experimental production of necrotic abscesses in the soft tissues of laboratory animals has been accomplished with mixtures of pure cultures of the spirochetes and fusiform bacilli with *Streptococcus haemolyticus* (anaerobic), or with mixtures of the streptococcus, vibrio, and fusiform bacillus. Pure cultures of only the spirochetes and fusiform bacillus mixed have not been found pathogenic.

Pulmonary lesions have been produced by intratracheal injections of sputum from known fusospirochetal pulmonary abscess and gangrene (Ribierre and Kermorgant;[28] Smith;[32] Bethune[4]). Pure culture of *T. microdentium*, or of the fusiform bacillus in an embolus was non-infective. A mixture of *B. melanogenicum* and *T. microdentium* produced a foul smelling abscess in the laboratory animal as in man (Herrmann and Cutler;[13] Alessandri and Visani[2]).

Staining characteristics will be considered later in the analysis of the clinical cases.

MODES OF INFECTION

Considerable study of the routes of pulmonary infection has shown that under general anesthesia and in normal deep slumber, saliva, oral foreign material (iodized oil), blood and nasal secretions are readily aspirated deep into the bronchial tree (Hölscher,[14] Hamilton[12]). The aspiration of iodized oil from the mouth and valleculae on attempt to swallow after local anesthesia of the oropharynx is well known. Hence it would not be strange for organisms, commonly saprophytic, to be aspirated from the mouth and pharynx, and under certain conditions to find a proper environment for growth in the lower respiratory passages.

It is possible that, in some cases, infected emboli may be transmitted to the pulmonary or bronchial circulation, but only probable in those instances wherein trauma of an already infected part has occurred. On the other hand, invasion of an infarcted zone with resultant poor reactive facilities, might easily occur on aspiration. There is some evidence that the spirochetes of this group are not viable in the blood stream (Smith[32]).

PATHOLOGY

The tissue changes in fusospirochetal lung abscess and gangrene have been described by Buday,[6] Arnheim,[3] and Zinserling[41] in Europe, Pilot and Davis,[27] Smith and Rusk[34] in the United States. In view of their anaerobic character, the fusospirochetal organisms thrive best in areas with poor oxygenation.

The stages of abscess and gangrene must have been preceded by an invasive period before the necrosis and liquefaction is accomplished.

In the present group of cases, no deaths have ensued to permit examination of the local lung tissue.

The pathologic changes in what logically must be considered an early period of invasion are described by Bethune in a personal communication regarding a patient who, on the day following laparotomy for gastroenterostomy, developed fever of 101.6° F., the next day 102° F., the third day a cough with a little sputum. The fourth day there were 3 ounces of sputum and clinical signs of bilateral bronchopneumonia. On the sixth day 8 ounces of foul sputum contained Dietrich's plugs with *T. vincenti*, *T. microdentium* and *T. macrodentium*, fusiforms and vibrios in almost pure culture. On the eighth day, shortly before death, 200 c.c. of yellow, turbid fluid was aspirated from the right base.

At autopsy both lungs were very large, heavy, edematous. All bronchi and bronchioles were plugged with casts of grayish, granular, purulent material which on dark field examination were practically solid masses of spirochetes, fusiform bacilli, and vibrios.

Microscopically there was extensive inflammation and edema with purulent exudate in the bronchi. Fixed sections (Levaditi stain) showed spirochetes in the lung tissues. The picture differed from ordinary bronchopneumonia in that the exudate was largely confined to the bronchial wall, with little involvement of the surrounding lung tissue. The diagnosis was "postoperative spirochetal bronchopneumonia and edema."

We are indebted to Dr. Bethune for the photomicrograph of a lung section (Levaditi stain) showing the spirochetes in this case (Fig. 1).

If this invasive bronchopneumonic stage should not resolve, necrosis and liquefaction or fibrosis would be expected to ensue.

The edema of the lung tissue (and resultant loss of alveolar air space) surrounding the acutely inflamed bronchi and bronchioles, their lumen filled with a purulent exudate, as described by Bethune, with the lymphatic infiltration described by Buday, might well produce on roentgenograms the appearance of a bronchopneumonia or a lobular pneumonia, with a patchy peritruncal infiltration, focal at first, tending to become confluent, and on resolution to leave more or less peritruncal fibrotic scarring.

Erb,[10] and McNeil, Macgregor and Alexander[22] have described the necrotizing processes leading to the production of bronchiectasis, and to a subsequent repair, as found in necropsy material from children with respiratory disease. It is conceivable that in several of our cases a similar process has given rise to the purulent sputum, streaked with blood. Insufficient opportunity to visualize the situation by bronchography during the acute phase precludes further deduction.

A further stage in such a process may account for the rapidly progressive pneumonic change appearing on roentgenographic examination with early evacuation of ulcerated or necrotic focal areas, and to which we have previously applied the term "suppurative pneumonitis." Sufficient evidence on the bacteriology and pathology is not available to warrant at the present full inclusion of that group in the fusospirochetal series.

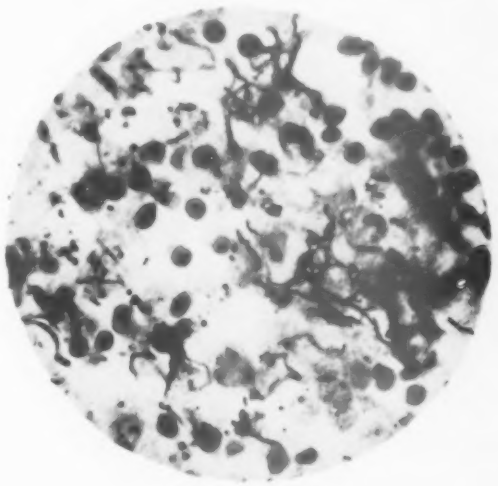


Fig. 1. Photomicrograph of section of lung. Fusospirochetal pneumonia (Levaditi stain). (Courtesy of Dr. Norman N. Bethune, Montreal.)

CLINICAL EVIDENCE

Our observation of 11 cases in the past year and a half leads us to believe that fusospirochetal pneumonia is comparatively common.* The clinical features are distinctive enough that the etiology may readily be suspected, and confirmed by adequate examination of the sputum. The immediate prognosis is good. There is a marked tendency to chronicity with more or less acute exacerbations. Early etiologic diagnosis and conservative treatment may lead to healing of the acute stages, and, in many, to the avoidance of serious late effects.

* Preliminary report by Henry Field, Jr., read by title, Society for Chemical Investigation, Atlantic City, N. J., April 30, 1934.

TABLE I

Case No.	Age	Sex	Predisposing Factor	Prodromal Period Length and Symptoms (in order of appearance)	Pulmonary Lesion (Roentgenogram)	Sequelae or Complications	Sputum	Blood	Length of Acute Illness (not including prodromal period)	Length of Convalescence	Treatment	Result; and Interval of Last Report
I 329569	24	M	Carious teeth. Poor oral hygiene	Three weeks. Dry cough, chill, fever to 102° F., pleuritic pain, sputum	Bilateral lobular basilar pneumonia	Pleural effusion 3rd hospital day; regression beginning 4th week, completed 6th week. Thrombophlebitis 7th–33rd day. No bronchiectasis	Initial specimen loaded with fusiform bacilli and spirochetes (gentian violet) persisting throughout hospitalization	White blood cells 8,000 increasing to 12,600 (polymorphonuclears 56%)	Fever until 5th week. Subtotal resolution by x-ray 7th week. Persistent minimal sputum until discharge	Two months	Bed rest; sodium perborate mouth wash, b.i.d.; arsphenamine 0.3, 0.3, 0.4 gm. 8th day, 9th, 11th days. 0.3 gm., 30th day; neoarsphenamine: 0.4, 0.4 gm., 33rd, 38th days	Residual interstitial fibrosis left base. Clinically well. Five months
II 131870 (Consultation case)	27	F	None Vincent's infection mouth three years before	Ten days. Cough, sputum, malaise, increasing fever to 102.4° F.	Pneumonic infiltration extending out from right hilus (old quiescent left apical minimal tuberculosis)	Some extension 5th day	*M. catarrhalis*, spirochetes and fusiform bacilli, occasional blood streaking. No acid-fast bacilli in several concentrated specimens	White blood cells 7,500 (polymorphonuclears 68%)	Fever for 9 days. Subtotal resolution by x-ray 19 days. Sputum until discharge	Not known	Bed rest. No arsenic	No sequelae reported by attending physicians. Clinically well. Seven months
III E.R.W. (Consultation case)	31	F	Poor oral hygiene	Five days. Pain upper abdomen, malaise, aches, cough with substernal pain, chills, fever 101°–102° F. Productive cough, blood streaked sputum	Bronchopneumonia base of right upper lobe (? resolving)	Slight infiltration left base twelfth day	Fusiform bacilli, spirochetes increasing 2nd hospital day then subsiding. Diplococci, streptococci, foul for short time	White blood cells 8,800 (polymorphonuclears 82%)	Fever 18 days. Sputum for 3 weeks. X-ray resolution 4th week	Not known	Bed rest. Sodium perborate mouth washes. No arsenic	Clinically well. Six months
IV 300690	16	M	None	Six days. Dry cough, fatigue for 5 days. Hemoptysis. Headache. Pleuritic pain. Blood streaked sputum. Fever 104° F.	Early bronchopneumonia left base	Increased to lobular in 4 days then subsiding	Spirochetes, fusiform bacilli. Pneumococcus IV. Sanguinopurulent for 7 days	White blood cells 22,400 (polymorphonuclears 88%)	Fever for 5 days. Maximum 104° F. second day. X-ray resolution 10th day. Sputum until discharge (19 days)	Two months	Bed rest. No arsenic	Clinically well. Three months

TABLE I—(*Continued*)

Case No.	Age	Sex	Predisposing Factor	Prodromal Period, Length and Symptoms (in order of appearance)	Pulmonary Lesion (Roentgenogram)	Sequelae or Complications	Sputum	Blood	Length of Acute Illness (not including prodromal period)	Length of Convalescence	Treatment	Result; and Interval of Last Report
V 162553	30	M	None	Eight days. Dry cough, hoarseness, chilliness, malaise, fever to 103° F.	Lobular pneumonia left base, bronchopneumonic infiltration right upper lobe	None	Mucopurulent, becoming tenacious. No streaking, diplococci, short chain streptococci. Numerous spirochetes	White blood cells 16,150 (polymorphonuclears 64%) on admission; W.B.C. 10,750 on 11th hospital day	Fever declining to 99° F. in 4 days. Normal in 7 days. Subjectively fairly well in 11 days. X-ray resolution 6 weeks	One month	Bed rest. No arsphenamine	Clinically well. Three months
VI 318457	16	M	None	Three weeks. Dry cough, malaise, fever to 100°, headache, weakness, loss 22 lb.	Confluent peribronchial infiltration right middle lobe. (? resolving bronchopneumonia)	Partial atelectasis right middle lobe with some bronchiectasis	Mucopurulent streptococci. Numerous spirochetes and fusiforms 1st time searched for (17th day). No further sputum obtainable	White blood cells 10,500 (polymorphonuclears 55%)	One week. Subjectively well. X-ray resolution of acute process in 3 weeks	Three months	Bed rest. Right temp. phrenic nerve palsy induced 4th week. No arsphenamine	Clinically well. No persistent bronchiectasis. Six months. Minimal peritruncal scarring right base. Ten months
VII 325471	16	F	Ether anesthesia for excision of lipoma of eyelid. Onset of symptoms in 24 hours, postoperative	Six days. Pleuritic pain fever to 101° F.	Bilateral lobular basilar pneumonia, greater on left, increasing for 2 days	Excavation of local axillary lesion, left, 6th week. Disappearing in 1 month. Fusospirochetal tonsillitis in 6th week	No spontaneous cough. Positive fusospirochetal tonsillitis in 6th week of disease	White blood cells 16,700 (polymorphonuclears 81%)	Prolonged low grade fever, maximum 101° F., for 41 days. Subjective marked improvement 2nd week. Subtotal x-ray resolution 5th week	Two months	Bed rest. Sodium perborate gargles. Postural drainage	Clinically well. Some ease of fatigue. Minimal peritruncal fibrosis. No residual cavity. Six months
VIII 310182	20	M	Tonsillectomy (local anesthetic). Onset of symptoms in 12 hours postoperative. Recent scarlet fever. Several dental cavities. No pyorrhea	Three days. Dry cough, fever to 104° F. Foul sputum (3rd day)	Confluent lobular pneumonia, right posterior lobe with local infiltration right axilla. "Suppurative pneumonitis"	Effusion for 4 weeks. *Atelectasis* of right posterior lobe with saccular bronchiectasis. *Re-aeration* beginning 12th week completed 4 months	Foul for 3 days. Hemolytic streptococci. Numerous fusiform bacilli and spirochetes. Increased following 2nd arsphenamine course in 4th month. Still present 8th month. No streaking	White blood cells 12,000 (polymorphonuclears 81% initial) W.B.C. 8,300 at 8 months	Eight weeks. Fever to 101° F. 2nd, 3rd week; 99.5–100° F. 4th to 8th week. Cough persisted. Subjectively improved beginning 3rd–4th week	Five months	Bed rest. Arsphenamine 5th week and 4th month (intensive); 2 thoracenteses 1st month. Bronchoscopy 6th and 10th week. Right phrenic nerve palsy	Minimal residual peritruncal fibrosis—minimal bronchial scarring, minimal pleuritic fibrosis. Clinically well. One year

TABLE I—(*Continued*)

Case No.	Age	Sex	Predisposing Factor	Prodromal Period Length and Symptoms (in order of appearance)	Pulmonary Lesion (Roentgenogram)	Sequelae or Complications	Sputum	Blood	Length of Acute Illness (not including prodromal period)	Length of Convalescence	Treatment	Result; and interval of last report
IX 214378	39	M	Hemorrhoidectomy (nitrous oxide anesthesia). Symptoms beginning in 72 hours postoperative	Twelve days. Pleuritic pain, malaise, dry cough, fever to 101° F., mucopurulent sputum 3rd day. Severe night sweats	Local pneumonic infiltration, right upper lobe, posterior axilla, increasing slightly for 5 days.	None	Not foul. Streptococci; few diplococci. Fusiforms and spirochetes (gentian violet) persisting for 9 days	White blood cells 14,400 (polymorphonuclears 70%)	Three days. Low fever and copious sputum rapidly subsiding. Cough for 2 weeks	Three months	Bed rest. Right temp. phrenic nerve palsy, induced 1st week. Arsphenamine (intensive) end of 1st week	Minimal peritruncal scar in axilla. Clinically well for 9 months
X 329712	42	M	Incision and drainage perirectal abscess (nitrous oxide anesthesia); carious teeth, poor oral hygiene	Onset 10 days postoperative. Pleuritic pain, cyanosis, cough, bloody sputum, dyspnea, fever to 102° F. No previous symptoms.	Early bronchogenic pneumonia right, diffuse increase in density as of some effusion day of onset of symptoms.	Effusion definite 3rd day, further consolidation of middle and posterior lobes with some decrease in fever. Began to clear in 4th week. Secondary involvement left lung with increase in symptoms 4th week	Bloody mucopurulent. Numerous fusiforms and spirochetes. Most marked end of 3rd week and 4th week. Persisting in decreasing numbers	White blood cells 22,000 (initial); 10,000, 7th week	Seven weeks. Subjectively well, fever subsided 5th week. Sputum in 6th. X-ray resolution subtotal 7th week	Two and one half months. Some râles persist	Bed rest. Sodium perborate mouth washes	Minimal residual pneumonitis right posterior lobe, minimal bilateral costophrenic pleuritis. Clinically well 2½ months
XI 316594	46	M	Severe pyorrhea	Recurrent attacks of pleuritic pain, cough with sputum. Slight fever, malaise for 7 months. One hemoptysis, some streaking 7th attack. No spirochetes, right temporary phrenic nerve palsy induced. Home on bed rest. Recurrence in 2nd week with fever to 103° F.	Primary: focal pneumonitis as of unresolved pneumonia, right axilla. Secondary: subtotal pneumonic consolidation of right upper lobe	None	Mucopurulent, slightly foul on 2nd admission for few days. Streptococci, spirochetes and fusiform bacilli. *Leptothrix*. Spirochetes persisted for 2 months	White blood cells 14,000 (polymorphonuclears 67%) 1st admission, 16,000 on 2nd admission, decreasing to 13,000	Five days. On 2nd admission maximum fever 101° F. Sputum persisting in decreasing amount. Progressive, rapid x-ray improvement	Four and one half months	Bed rest. Previous palsy of right phrenic nerve. Arsphenamine (intensive) 2nd week. Sodium perborate mouth washes	Minimal parenchymal and pleural scarring. Clinically well 6 months

The 11 clinical cases, 10 of which we regard as relatively acute, 1 a chronic recurrent, are presented in abstract in Table 1.

ANALYSIS OF CASES

The predominance of young males in the series was interesting but no inference should be drawn from so small a group.

Of *predisposing factors*, in over half the cases there were none. In 2 patients the onset was within twelve hours postoperative (1 a clean field, minor, with general anesthesia; 1 a secondary tonsillectomy under local anesthesia). Onset in another was in three days after hemorrhoidectomy under nitrous oxide-oxygen anesthesia, and in a fourth ten days after incision and drainage of a perirectal abscess under nitrous oxide-oxygen anesthesia. One case was seen in the fifth and sixth exacerbations of a relapsing pulmonary infection already lasting over seven months.

Two patients had had a Vincent's infection of the mouth several years previously. Three others had carious teeth, and 2 of those pyorrhea. None had evidence of previously infected tonsils, although the tonsillectomy patient had been under quarantine the month before for scarlet fever.

Initial symptoms included dry cough, slightly productive cough, fatigue, hemoptysis, pleural pain, fever, chill, and headache. Non-productive cough and fatigue or malaise were the most prominent. The duration of these before notable distress was a matter of a day to several weeks.

Ten of the patients had fever before or upon admission; the highest initial fever was 103° F., the highest recorded during hospitalization 104.2° F. It was septic in course, tending to subside gradually as by lysis with a low fluctuation above normal over a relatively long period, and subject to recrudescence.

Cough was immediate in onset in 10, the eleventh beginning on the second day of illness. The cough was commonly non-productive for a variable period up to three weeks after onset.

Hemoptysis accompanied the onset in one case, streaking was common, although not prominent after advent of sputum. In one case sputum was uniformly the color of crushed strawberries (Case IV). Three cases had foul sputum for only a short period (Cases III, VIII and XI). Instead it had a musty, sweetish odor, best described as "mousy." The organisms most commonly identified in the initial sputum specimens on routine examination were short-chain streptococci (not identified further), *Streptococcus haemolyticus*, occasional diplococci and bacilli, in one case pneumococcus, Type IV, and in another *Leptothrix*. In most cases the spirochetes and fusiform bacilli were overlooked in the routine examination. They were identified when special search was made for them. The fusospirochetal organisms were more numerous as the sputum became copious. This corresponded closely with the early stages of regression as demonstrated by the serial roentgenograms. There was not a ready disappearance of the spirochetal forms after arsenical therapy.

Moderate secondary anemia was common in the more protracted cases. Leucocytosis on admission ranged from 8,000 to 21,000 with an average of 13,700. The polymorphonuclear cells varied from 64 to 88 per cent, lymphocytes 8 to 26 per cent, monocytes 2 to 17 per cent with an occasional eosinophile, the polymorphonucleosis occurring during the more acute phase. In general, the leucocytosis tended to parallel the course and extent of the pulmonary involvement as seen on roentgen studies, with occasional marked fluctuation.

The blood serology was negative in the entire group.

The urine showed no significant changes.

The physical signs of pulmonary involvement did not parallel in extent or degree the manifest changes in the lungs on the roentgenograms. Râles were more common in the resolving period.

Roentgen Pathology. The roentgen manifestations of the infection were characterized by a slight initial increase in density along the bronchovascular trunks of the lung (Plate I, Fig. 2, Case IV; Plate II, Fig. 8, Case V), followed by rapid development of a hilar infiltration and further increase in density about the truncal shadows (Plate I, Fig. 3, Case IV). This was in turn succeeded by a patchy parenchymal infiltration of exudative type tending to become confluent, to present an appearance of local pneumonic consolidation and in others (Cases VIII and XI) lobar consolidation (Plate V, Fig. 20, Case VIII). This progression we have interpreted as an initial bronchitis with subsequent peribronchitis, bronchopneumonia, edema or inflammation of associated secondary

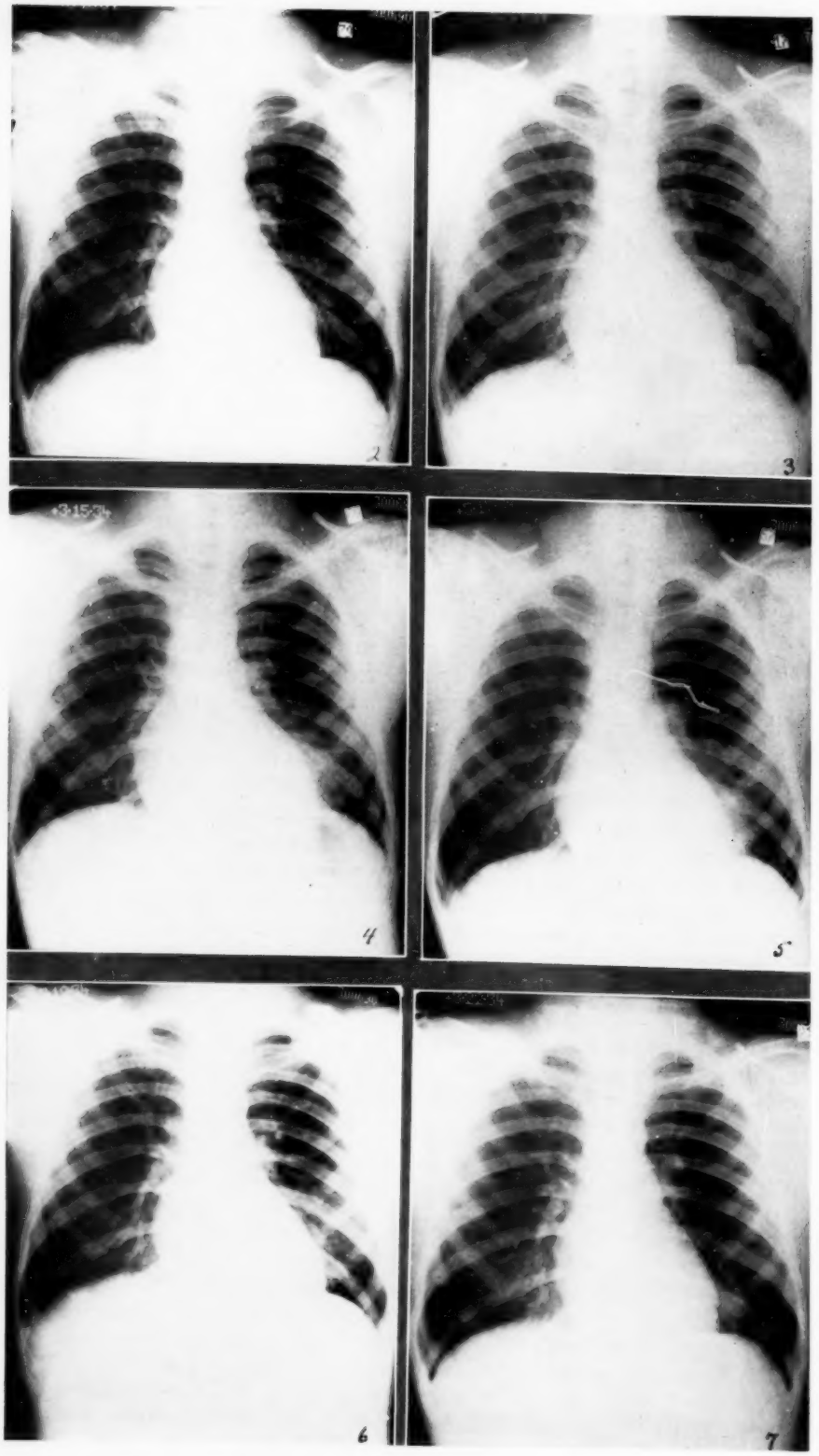


Fig. 2. Sixth day of illness, blood-streaked sputum, slight coarsening of bronchovascular trunks left base.

Fig. 3. Seventh day, *lobular pneumonia* left base. Pneumococcus IV. Spirochetes.

Fig. 4. Eighth day, moderate increase.

Fig. 5. Tenth day, organization, temperature normal.

Fig. 6. Twelfth day, subtotal resolution.

Fig. 7. Fifteenth day, minimal peritruncal residuum, clinically relatively well. Bed rest only.

Plate I. Case IV (300690). Aged sixteen. No predisposing factors, sudden onset, cough, fatigue, fever.

lobules as of a lobular pneumonia, and then confluence or consolidation of a part of, or an entire lobe. Resolution was manifested by irregular focal rarefaction, almost suggesting the liquefaction and evacuation of a suppurative pneumonitis, but without the relatively sharp subtotal atelectasis of the right posterior lobe persisted for some time, finally clearing gradually with re-aeration and almost complete resolution of its surrounding pleural reaction. At one phase in the reëxpansion a prominent pleuropericardial adhesion was visible, later to dis-

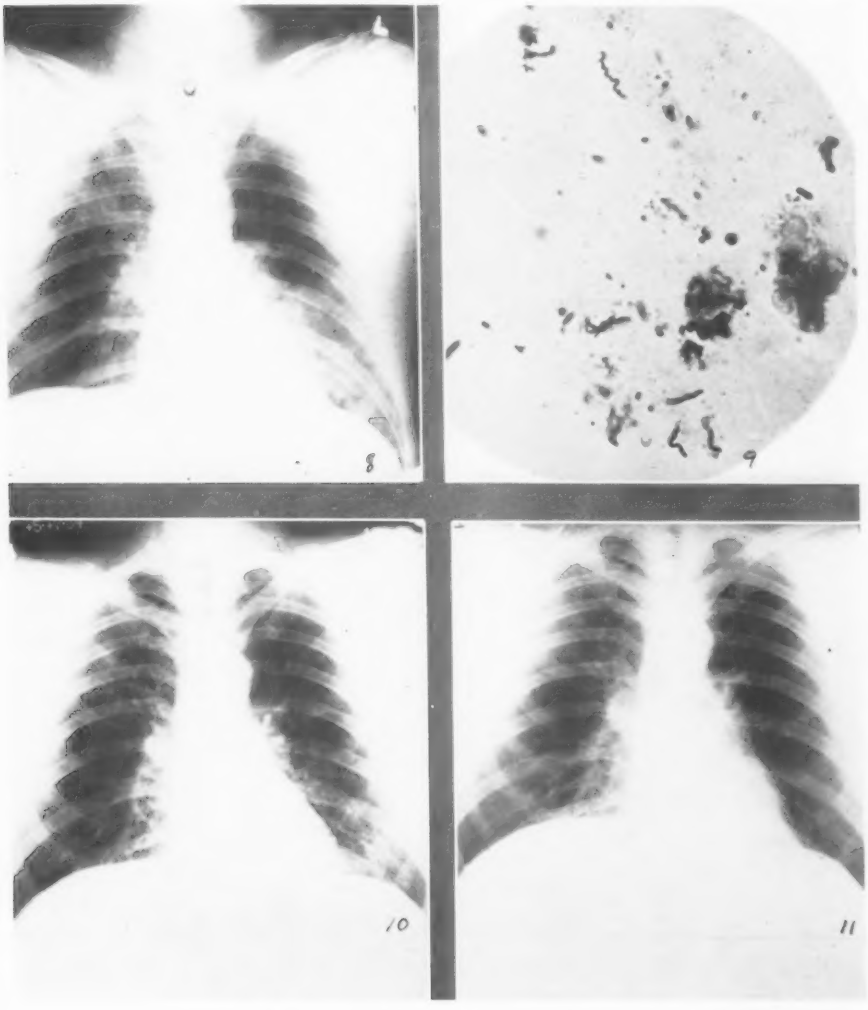


Fig. 8. Eighth day of illness, *lobular pneumonia* left base, peribronchial infiltration right upper lobe.

Fig. 9. Photomicrograph of sputum specimen (Farrier silver stain); spirochetes, diplococci.

Fig. 10. Ninth hospital day, sixteenth day of illness, no fever, resolution of left base.

Fig. 11. Six weeks—complete resolution.

Plate II. Case V (162553). Aged thirty. No predisposing factors, dry cough, hoarseness, chilliness, malaise, fever to 103° F., for eight days.

outline of the cleared areas. With this, or in others wherein the lesions had not become confluent, there began a regression of the parenchymal infiltration. Subsequent progressive clearing along the bronchovascular trunks was evident.

Contralateral infection or spread on the same side was rather common with a similar cycle (Plate III, Case VII).

In one patient (Plates V and VI, Case VIII) a appear. In this case and one other (Case VI) bronchiectasis as well as atelectasis was demonstrated by instillation of iodized oil. Later bronchography (six months) demonstrated apparent complete resolution of the bronchiectasis of the right middle lobe in Case VI and a marked diminution in the irregularity and dilatation of bronchi in the previously atelectatic right posterior lobe of Case VIII.

Resolution left no appreciable roentgen evi-

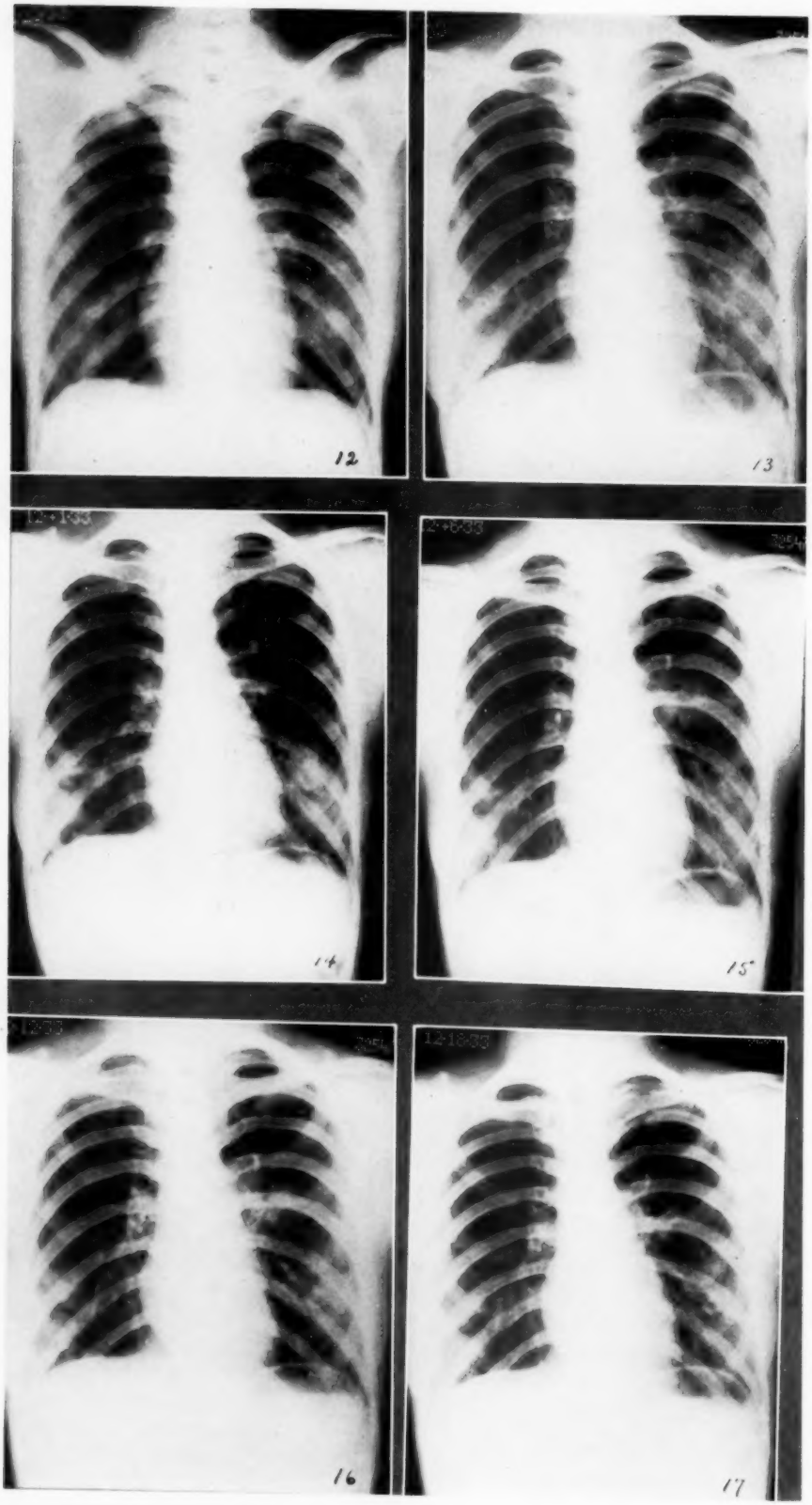


Fig. 12. Seventh postoperative day, *bilateral lobular pneumonia.*

Fig. 13. Ninth day, increased pneumonic involvement.

Fig. 14. Fifteenth day, temperature 99.5° F. Slight resolution right.

Fig. 15. Twentieth day, temperature 101° F. Increased involvement left.

Fig. 16. Twenty-seventh day. Moderate organization both sides.

Fig. 17. Thirty-third day. Focal abscess left lung—next day fever and acute fusospirochetal tonsillitis; clearing with sodium perborate.

Plate iii. Case vii (325471). Aged sixteen. Excision lipoma of eyelid (ether anesthesia); onset pleuritic pain and fever to 101° F. in twenty-four hours postoperative.

dence of scar in 5 cases. Four had minimal linear scars, the other 2 cases more or less peritruncal scarring associated with the known atelectasis and bronchiectasis. These were diminishing progressively at the last examination six months after the acute illness.

Pleural reaction (thickening or effusion) was observed in 5 of the 11 cases, 3 being grossly involved. The appearance of roentgen evidence of pleural reaction followed the pleuritic pain by from five to seven days. Two cases were subjected to thoracentesis. Both showed a blood-tinged, turbid fluid which yielded no organisms on smear or culture. A pleural reaction appeared on the initial film in 2 patients (Cases I and IV) and was observed in association with rise of temperature in a third (Case X). In this patient the fever and effusion initiated a recrudescence on the side of the initial lesion, and a second time the later involvement of the contralateral lung. All 5 cases on resolution presented a minimal to no pleural thickening.

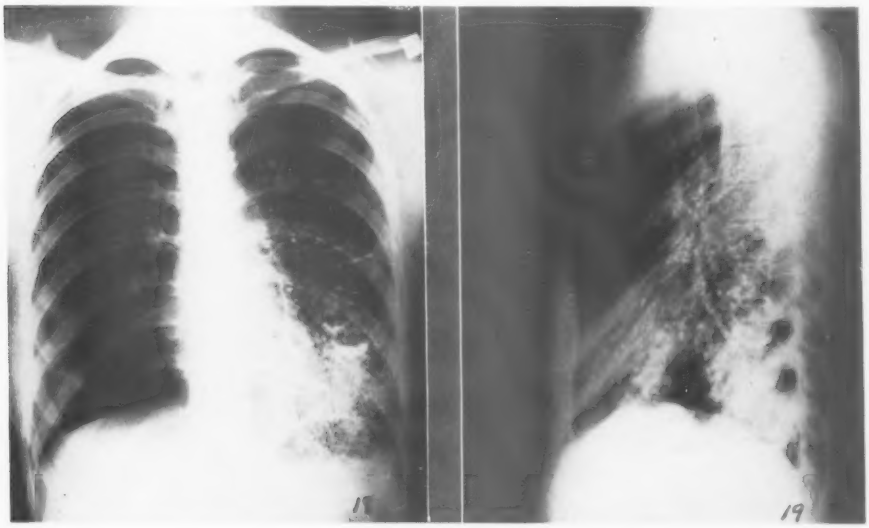
We have eliminated from this series all cases of pulmonary abscess with fusospirochetal organisms, except that Case VII (Plates III and IV) at one time showed a local excavation in one of the involved areas—following almost complete resolution of the primary lesions in both lungs. The patient was under observation throughout her entire course. Although no positive sputum was obtained, because the pattern of the disease in her case follows so closely the other and she developed a positive fusospirochetal follicular tonsillitis during convalescence, we feel justified in the inclusion of the case here. Later bronchography of the area did not demonstrate the persistence of the excavated area.

Treatment. Complete bed rest, sedative for cough, and in 2 cases postural drainage was the general routine. Mildly antiseptic mouth washes, and on occasion sodium perborate gargles, were employed.

Temporary phrenic paralysis was induced in 4 cases.

Four of the 11 patients received arsphenamine or neoarsphenamine, all on an intensive schedule. Two of these 4 cases received two courses. Spirochetes continued in appreciable number in the sputum for nine weeks to three months subsequently. There was not a marked clinical change following the intravenous therapy.

Duration. The elapsed time from onset of the prodromal period to the subsidence of fever or other symptoms and the disappearance of the roentgen evidence of active pulmonary abnormality occupied from twenty-four days to nine months. Contralateral spread, pleuritis with effusion, or atelectasis increased the length of time. The period of hospitalization varied from nine days to four months. Four patients were hospitalized over one month. The shortest convalescent period was one month (Case V).



Figs. 18 and 19. Bronchogram—forty-sixth day. Local excavation in suspected area. Subsequent complete clinical cure.

Plate IV. Case VII (325471).

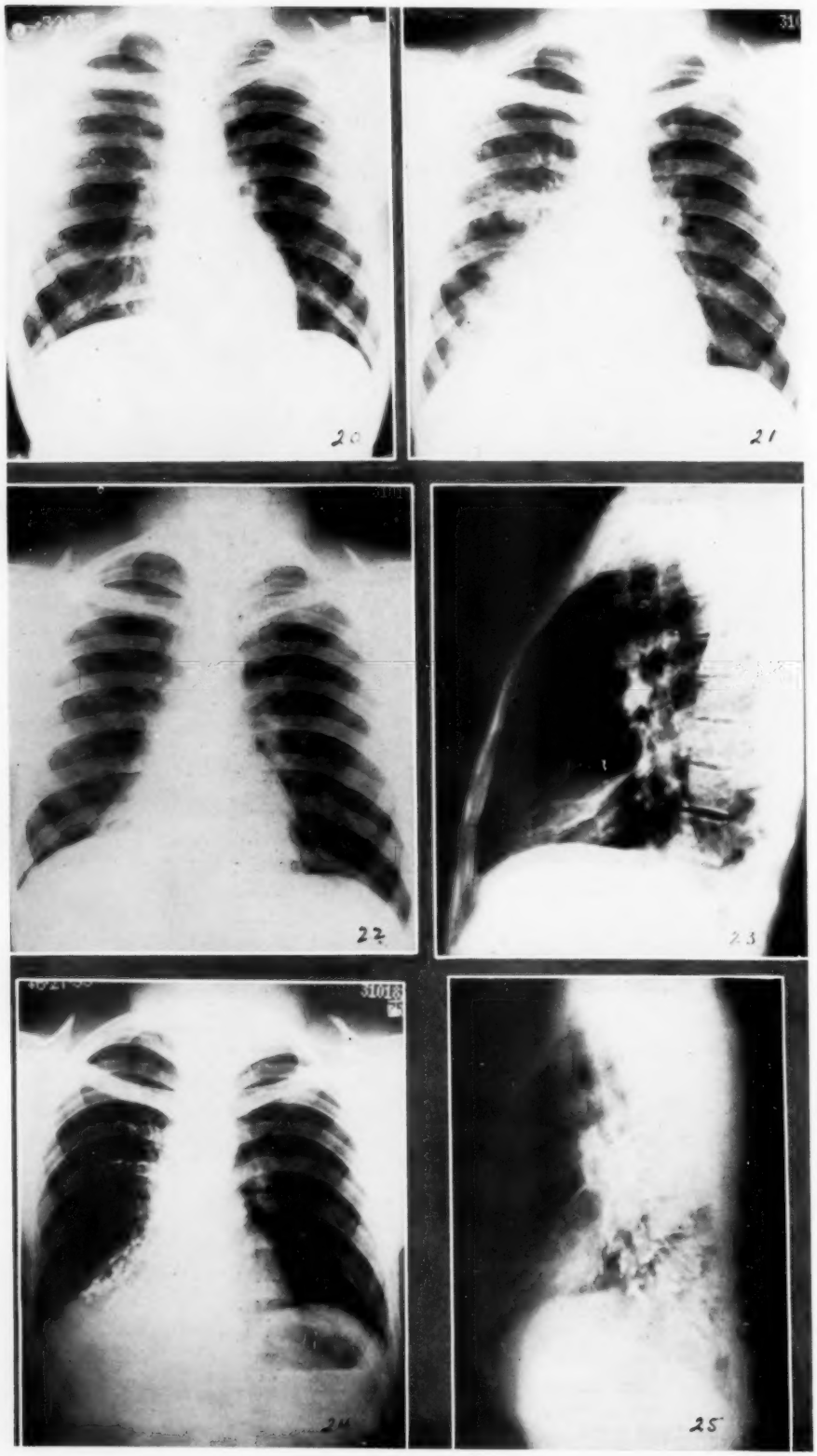


Fig. 20. Chest examination one month before—essentially normal.

Fig. 21. Third day postoperative. Temperature, 103° F., foul sputum. Confluent lobular pneumonia predominantly posterior lobe.

Fig. 22. Fourth week. Partial atelectasis of posterior lobe right. Persistent fusospirochetal sputum.

Fig. 23. Lateral view, same day.

Fig. 24. End of second month. Bronchiectasis in previously infected and atelectatic posterior lobe. Right phrenic nerve palsy (surgical).

Fig. 25. Lateral view, same period.

Plate v. Case viii (310182). Aged twenty. Tonsillectomy (local anesthesia). Dry cough, fever to 104° F., beginning twelve hours postoperative, foul sputum third day.

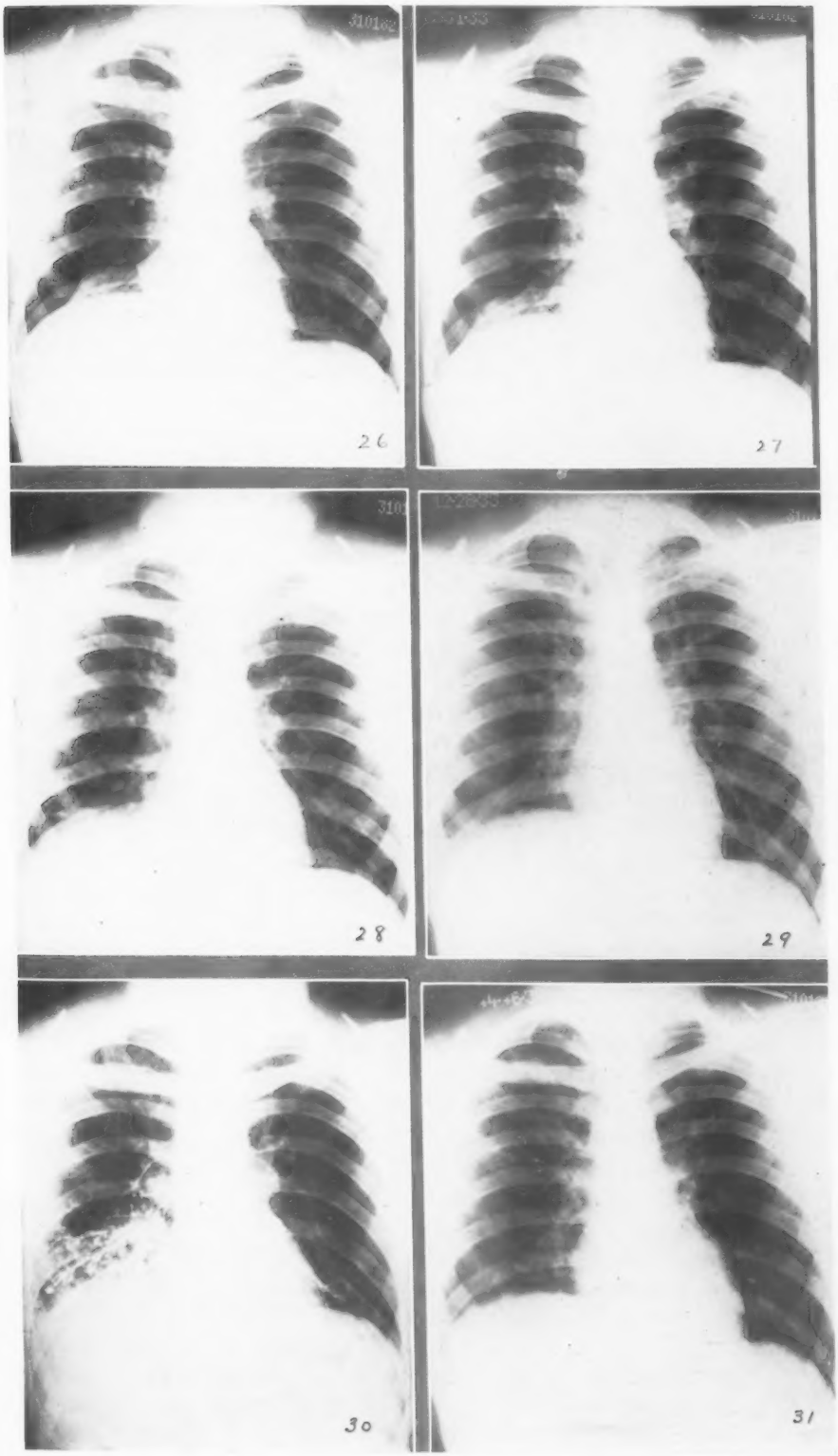


Fig. 26. End of third month. Re-aeration of posterior lobe beginning, pleuropericardial adhesion.

Fig. 27. Fourteenth week. Further clearing; fusospirochetal organisms persisted in sputum.

Fig. 28. Sixteenth week. Persistent spirochetes.

Fig. 29. Eighth month. Apparent clearance of atelectasis.

Fig. 30. Ninth month. Minimal residual scarring of previous bronchiectatic area.

Fig. 31. One year—clinically well, minimal fibrosis.

Plate vi. Case viii (310182).

Fig. 32. Case III (E.R.W.). Aged thirty-one. Previously known pyorrhea alveolaris, acute pleural and pneumonic onset with blood-streaked sputum. Numerous spirochetes in sputum specimen (silver stain-Fontana).

DISCUSSION

The determination of the relationship of the fusospirochetal group of organisms to disease of the lung has not been simple. The mere presence of such organisms in association with a disease is not proof of etiologic relationship. We have referred above to the observations by others and their analyses of the evidence in lung abscess and gangrene.

Our belief in the etiologic importance of the fusospirochetal group of organisms in this present series is based not only on the occurrence of such organisms in the sputum in relatively large numbers at some period in the disease. These cases have run an obviously different course from ordinary bronchopneumonia.

Predisposing factors of carious teeth, or pyorrhea, and operative anesthesia with its attendant opportunity for aspiration of saliva have presented in a large proportion of the group. One patient developed a fusospirochetal follicular tonsillitis during convalescence under observation. Two cases with no previous relevant history apparently developed bronchiectasis (Plate v) early in their infection and a third (Plates iii and iv) a small, thin-walled pulmonary excavation, lesions that have been peculiarly closely associated with fusospirochetal infection. (It is of interest that many observers have considered these organisms to be late contaminants in bronchietasis). Further, the pattern of the initial acute stage of the disease, and its roentgen manifestations, closely follows the course and prodromal stages of lung abscess (Doub,[9] Allen[1] et al.[5, 11, 13a, 15, 24]).

If one accepts the evidence that the fusospirochetal organisms may produce pulmonary disease, the significance of such organisms in the sputum will depend upon their prevalence and the conditions under which they are found. Although present in large numbers, the demonstration of these organisms by the usual clinical laboratory methods is not certain. Fresh specimens are desirable, although in our series fairly numerous spirochetes have been found on gentian violet smears of specimens which were several hours old. On the other hand, the aniline dyes will visualize only a small proportion of the spirochetes in many fresh sputum specimens.

The silver stains make very beautiful, permanent preparations (Fig. 32, Case III, Plate II, Fig. 9, Case V) but the technique is laborious for routine work. For diagnostic purposes dark field examination will demonstrate the organisms in a few moments. If equipment for this is not available the gentian violet smears will be of great assistance. Variability in frequency of organisms and depth of staining makes the examination of several specimens desirable, particularly the small grayish plugs which may be teased out of the washed specimens.

It is apparent that the clinical course has shown considerable variation in our cases. The outstanding features seem to be a prodromal period in symptoms and roentgen changes suggesting a bronchitis with unproductive cough, intermittent fever, or a "cold" which may not induce the patient to seek medical attention. This usually is followed by a period of evolution of a pneumonia, tending to be lobular in roentgen

appearance, a constitutional reaction quite mild in comparison with the extent of pulmonary involvement, a slow and prolonged period of resolution, tendency to exacerbation, and with a more or less characteristic sputum. Even when onset was indicated by acute pleuritic pain, the fever was commonly mild, the pulmonary symptoms slow in appearance.

The temperature is irregular, commonly a decreasing daily elevation for some time after the acute spike of the onset of definite pulmonary changes and closely paralleled by a moderate polymorphonuclear leucocytosis. Finally, the roentgen changes do not conform to the usual pattern of either bronchopneumonia or lobular pneumonia alone. It is our opinion that in these 11 cases we have dealt with a disease entity of distinct etiology.

SUMMARY

1. Fusospirochetal pneumonia is presented in a series of 11 cases as a disease entity of definite etiology.

2. It is characterized by a prodromal period, more or less prolonged, with dry cough, malaise, and pleural pain as dominant symptoms.

3. The gravity of the roentgen evidence of a subsequent bronchopneumonia to confluent lobular pneumonia is out of proportion to the relatively mild constitutional reaction.

4. The sputum commonly has a "mousy" rather than a foul odor, is sometimes bloody, and contains many fusiform bacilli and spirochetes, in addition to other organisms commonly associated with them in the mouth. Dark field examination and gentian violet or silver stains of fresh-washed specimens are advisable in the suspected case.

5. There is a considerable tendency to exacerbation, spread of involvement, pleural effusion, or atelectasis.

6. Convalescence is commonly slow. Conservative treatment with complete bed rest has yielded excellent results.

7. Bronchiectasis has been observed early in the course of two cases, followed by partial to complete repair.

8. Arsphenamine and neoarsphenamine have not been of marked therapeutic value.

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DISCUSSION

Dr. Fred M. Hodges, Richmond, Va. Drs. Peirce and Field have done us a real service in closely coordinating their cases from both the clinical and roentgen viewpoint. Their interest and perseverance in following each individual patient throughout the entire course of illness clinically and by serial roentgenograms has given us much exact information, obtainable in no other way.

Their films take us from a normal lung to peritruncal thickening, to peritruncal infiltrations, to lobular pneumonia, to consolidation of large lung fields, to pleural fluid to bronchiectasis and through regression on back to a normal lung.

The lungs have shown less residuum than I would have expected and the bronchiectasis has cleared up more rapidly than most of us would have expected. The early treatment must have been responsible for a lot of this. The fact that all of the patients were young was an advantage.

It has been our experience that it is almost impossible to get any two clinicians, roentgenologists or pathologists to agree upon the frequency, the characteristics or the impor-

tance of this condition. Men of equal ability and experience hold very diverse views. Some believe that almost any type of pulmonary pathology from simple, hemorrhagic or fetid bronchitis to bronchopneumonia, bronchiectasis, abscess and gangrene can be and frequently is due to fusospirochetal infection. Some believe that only the suppurative lesions are due to it, while others contend that these organisms are secondary invaders.

The treatment is almost as controversial. Some believe that arsphenamine in intensive doses is very valuable, particularly in the early cases, others that arsphenamine is only of value where there is also a positive Wassermann, and still others doubt that it is of any value.

I have been especially interested in this subject since Smith's work came out in 1927, and since that time have been fairly closely associated with a fusospirochetal enthusiast. For several years I was definitely skeptical, but now believe that these infections must be fairly frequent.

Too much evidence supports this view to disregard it, in spite of the fact that it has been impossible up to this time to prove without doubt that these organisms are primary invaders.

We have used a very simple classification of fusospirochetal infections, placing all types in three groups: (1) bronchitis of various types and early bronchiectasis in which the roentgenogram has been of little value except of course after lipiodol in the latter; (2) parenchymal changes, infiltration or consolidation varying widely in type, extent and distribution. This group includes the pneumonic type and the cases that closely simulate tuberculosis both clinically and on the film; (3) suppurative lesions.

Probably due to our limited experience we have not been able to diagnose this condition from the roentgenogram alone. As the essayists have pointed out, the amount of pathology present is usually out of proportion to the symptoms and when the lesions are in the lower lobes we should suspect this infection, but with us the final diagnosis has invariably been made by the clinician and bacteriologist. I believe we should be fusospirochetal-minded but must be careful not to go too far.

The experience of Drs. Peirce and Field with arsphenamine is, as the Negro would say, "most disencouraging." They have proved the value of early diagnosis and symptomatic treatment. We believe that arsphenamine in intensive doses has been of great value in some of our patients, especially the early bronchial spirochetosis type. In others, the disease has progressed in spite of treatment.

The large number of spontaneous recoveries in this condition makes it almost impossible to determine the efficacy of a drug in a small series.

From a practical standpoint, prophylactic treatment offers much more—since practically all mouths where there is any form of oral sepsis contain myriads of these organisms. It is not only the duty of the surgeon, when contemplating an operation anywhere, and especially on the upper respiratory tract, but also of the roentgenologist before intensively irradiating this area, to see that oral sepsis is as far as possible eradicated. We should in this way in our work be able to prevent some of these infections—regardless of what the future may prove the etiological factors.

ROENTGENOLOGIC DETERMINATION OF NORMAL AND ABNORMAL RESULTS FOLLOWING OPERATION ON THE STOMACH AND DUODENUM*

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FOLLOWING surgical operations on the stomach and duodenum, roentgen examination is often demanded to determine whether the mechanical and functional results are satisfactory, or whether the disease for which the operation was performed has recurred, or whether new complications have arisen. For patent reasons this field of roentgen diagnosis is likely to be difficult, and in order that the examiner may carry out his task more efficiently he should be informed so far as possible as to the fact of a previous operation, the condition for which it was performed, and the character and extent of the surgical procedure. When the roentgenologist is familiar with the surgical technique employed in the case at hand, he is better able to judge the results than when the operation was performed by methods with which he is not acquainted.

The roentgenologic technique should be substantially that usually employed for examination of the gastroduodenal tract, but it should be applied with even greater care. If the stomach is filled immediately with the barium mixture, any stoma which may have been made will be difficult to inspect and the mucosal relief will be largely concealed. Hence, the barium should be given slowly at first and the course of each swallow observed before the next is taken. By manipulation, small amounts of the mixture can be distributed over the mucosa to reveal the internal relief. Suture lines should be inspected with especial care, for they are common sites of recurring lesions. If gastroenterostomy has been performed, the bolus of barium should be followed through at least the first 12 cm. of the efferent limb, and the afferent limb should also receive attention. Later the barium may be given in quantity to bring out the visceral contour. The examiner should not hastily conclude that a stoma has closed if no barium passes through it during the early part of the examination, especially when the operation has been performed recently. In doubtful cases the patient should be allowed to rest for a few minutes; often on resuming the examination the stoma will be found to be freely patent.

NORMAL RESULTS AFTER OPERATION

Inflexible standards for normal results cannot be established, for even those operations that are similar must vary according to the particular circumstances, and the examiner should be cautious in judgment. However, effects commonly to be expected from the various operations are substantially as follows:

Gastrojejunostomy. The roentgenologist should not be too critical of the appearances observed during the first weeks after gastrojejunostomy. Usually the stomach is somewhat atonic and contains more or less secretion. At the stoma the line of suture may be visibly irregular, tissues in the area are evidently swollen, adjacent gastric rugae are ill-defined, and passage of the suspension of barium through the stoma is less free than might be expected (Fig. 1 *a*).

Later, after several weeks have elapsed, all signs of reaction have vanished, gastric tonus has been regained, and the stoma now performs its function more liberally. The first two or three swallows of barium

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are likely to go through the stoma unimpeded, but as more of the suspension is taken, its passage through the stoma becomes intermittent and more or less rhythmic. At one time this intermittence was attributed to the development of sphincteric control at the stoma, but an anatomic basis for this hypothesis has not been found, and it has been shown rather conclusively that the intermittent outflow is due to alternate contraction and relaxation of the jejunum. To this, possibly, is added alternate slight diminution and enlargement of the stoma by tonic contraction and relaxation of the stomach and by peristaltic movements. If the gastric outlet is not obstructed by a lesion, and the pylorus was not blocked at operation, part of the mixture of barium will make its exit by this route, but as a rule the gastric content will be evacuated chiefly through the stoma. It is noteworthy that even after many years the stoma does not tend to close, except as a result of marginal ulcer or other disease. If the pylorus was blocked by sutures it will not remain closed, and usually reopens within a few weeks.

If a bariumized motor test meal is given there should be no residue from it in the stomach, duodenum, or jejunal loop after six hours. The stomach usually will empty much more quickly than one which has not been subjected to anastomosis, but no standard time limit can be set for evacuation. Certainly when the usual quantity of barium suspension is given, not all of it should be discharged within the few minutes required for examination, nor should evacuation be as slow as that of the normal stomach, but between these limits there is a wide range for results which may be considered satisfactory.

Apparent diminution in size of the stomach is a conspicuous effect of gastrojejunostomy, and the shrinkage is emphasized by the difficulty of fully distending the stomach, owing to the rapid outflow of the mixture of barium. A stomach which, before operation, was a long, dilated, pendulous sac now contracts to moderate size and lies transversely.

At the site of the stoma the gastric contour is slightly dimpled, but is otherwise not deformed unless by gastric lesions, their scars, or the scars from their resection. In general the mucosal relief is not altered by gastrojejunostomy although, because the stomach is not fully expanded by the ingesta, the gastric rugae may appear to be accentuated. If sufficient time has elapsed since operation, the reactive hyperemia and edema at the anastomosis has

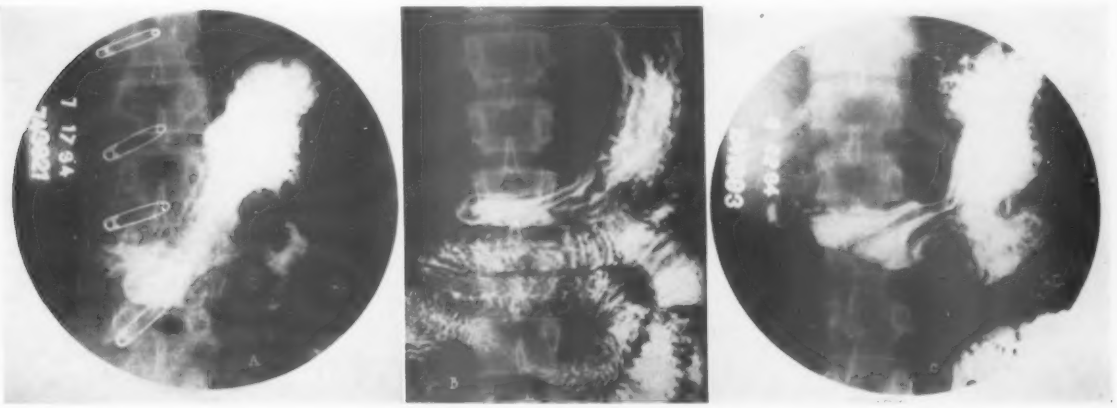

Fig. 1. Normal gastroenterostomy. *a*. Appearance nineteen days after gastrojejunostomy. Deformity about the stoma probably is due to reactive swelling and will disappear later. *b*. Normal mucosal folds of the stomach and jejunum at the site of anastomosis. A considerable period has elapsed since operation. *c*. Stomach and distal loop of jejunum filled with barium.

disappeared, and the rugae extend to the stoma where they blend with the valvulae conniventes of the jejunal loop (Fig. 1 *b*).

As a rule, gastric peristalsis appears to be less marked after gastrojejunostomy, but its character is not of great significance, unless it is definitely accentuated or reversed as a result of postoperative complications, and the examiner is not likely to study it closely. Interested observers have found that the waves continue their progress to the pylorus.

whether the gastrojejunostomy is of the posterior or anterior type and whether the efferent limb of the jejunal loop is turned to the left or the right. As anterior anastomosis is employed much less often than posterior anastomosis, and as the stoma is often less amenable to manipulation for inspection, the examiner may have difficulty in judging results. It requires a longer proximal loop than posterior anastomosis, and this factor must be taken into account.

Billroth I. Early after resection of the

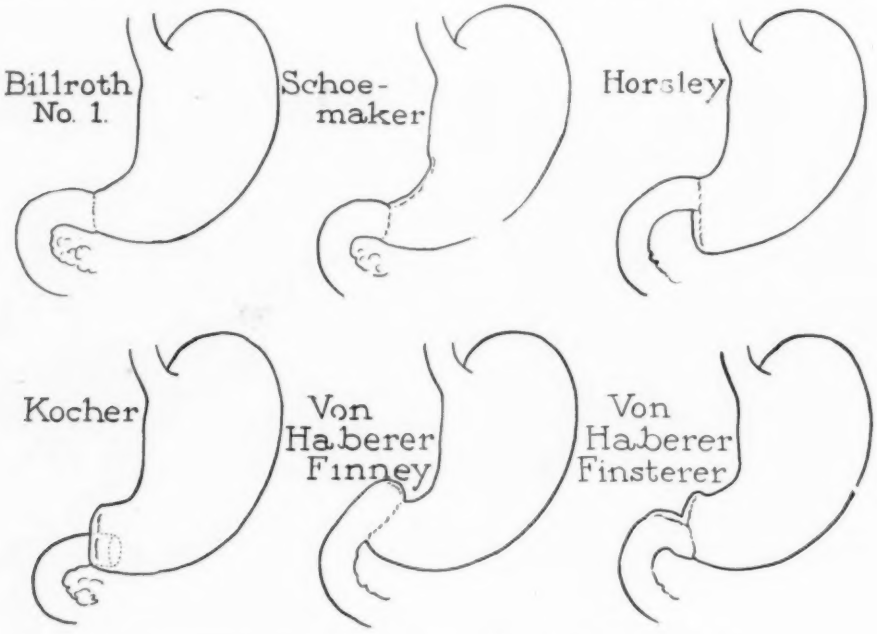

Fig. 2. Drawings illustrating various modifications of the Billroth I operation.

Because of its high transverse position and the attachment of the jejunum, the stomach is not freely mobile, but definite fixation by adhesions caused by the operation rarely occurs.

Unless affected by disease when the operation was performed, the duodenum throughout should not be narrowed, dilated, distorted, or obstructed. The afferent and efferent limbs of the jejunal loop should be of normal caliber, and should present the usual markings of the valvulae conniventes (Fig. 1 *c*).

All these considerations apply equally

pyloric portion of the stomach, and reunion of the remainder of the stomach with the duodenum, the line of suture is hyperemic and irritable, and passage of the barium usually is not as free as one might expect, although observers have reported instances in which the outflow was voluminous, due perhaps to an unusually large stoma. The stomach is, of course, diminished in proportion to the amount resected, but often the remnant is still relatively dilated and may contain fluid. If, in accordance with certain modifications of the operation (Fig. 2), the gastric incision was partially closed

before the duodenum was attacked, the resulting deformity at the anastomosis will persist for a time (Fig. 3 *a* and *b*).

Later, after complete restoration and accommodation to the new conditions, exit of the mixture of barium becomes quite free but not continuous, and the outflow is evidently restrained by rhythmic contractions of the duodenum. Notwithstanding this control, the time required for evacuation is greatly shortened and is even shorter than that after gastrojejunostomy without resection. Irregularities at the line of junc-

tracted, often contains fluid, and during the first few minutes of examination the outflow of barium is often so scant that the stoma may seem inadequate.

After healing is complete, the gastric sac contracts and becomes funnel-shaped, and evacuation is extremely rapid but not continuous. Judging from roentgenologic manifestations only, efficient function seems to be regained more rapidly after the Pólya operation than after the Billroth (Fig. 4 *a*, *b*, *c*).

Sleeve Resection. Shortly following sleeve

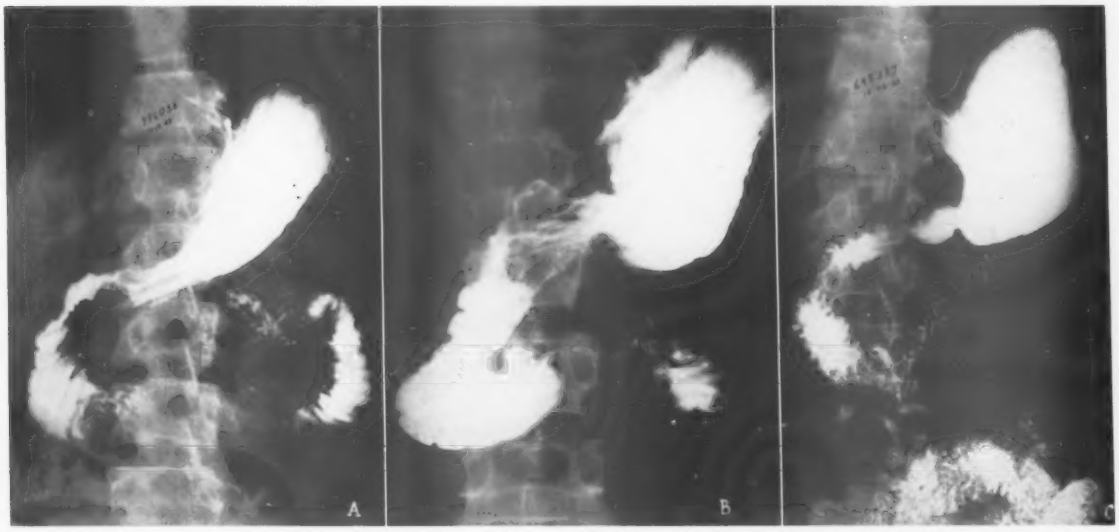

Fig. 3. Normal results following Billroth I resection. *a*. Schumacher's modification of Billroth I. Appearance three weeks after operation. *b*. Billroth I with partial duodenectomy; three weeks after operation. *c*. Normally functioning Billroth I; two years after operation.

ture gradually disappear, although some observers have noted persisting slight constriction at the line of suture (Fig. 3 *c*). Other investigators have called attention to exaggeration of the rugae at the anastomosis, evidently caused by the end of the stomach being contracted to conform with the smaller caliber of the duodenum.

Billroth II; Pólya; Roux. When the patient is examined shortly after resection of the stomach, with closure and posterior gastrojejunostomy or anterior gastrojejunostomy (Billroth II) or anastomosis directly at the line of resection (Pólya; Roux) the remaining sac has not yet con-

resection of the stomach, more or less hourglass contraction is visible at the line of suture on one or both curvatures. Subsequently, the contraction diminishes or disappears, and the distal segment tends to become smaller, either actually or relatively. It has been doubted that peristaltic waves cross the line of resection, but as a matter of fact the waves may continue to the pylorus (Fig. 5 *a*, *b*, *c*).

Total Gastrectomy. After total gastrectomy the segment of small bowel attached to the esophagus gradually expands to form a reservoir from ingestion. The dilatation is greatest immediately below the

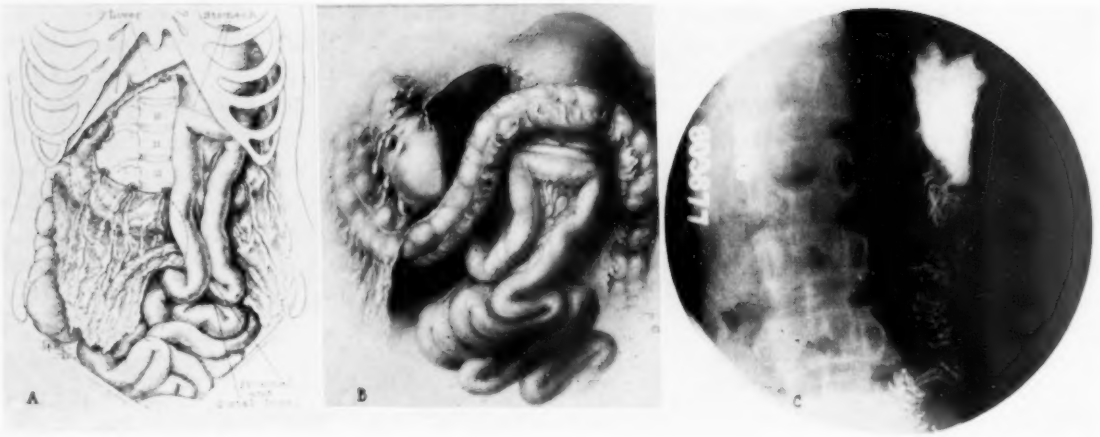

Fig. 4. Pólya resection. *a*. Balfour-Pólya resection, anterior loop. *b*. Pólya resection, posterior loop, *c*. Normally functioning Pólya resection, posterior loop; one and a half years after operation.

esophagus, and distal to this expansion there may be several lesser dilatations between which are short segments of undilated bowel. Passage of the mixture of barium is rapid (Fig. 6 *a*, *b*, *c*).

Local Resection. After excision of an ulcer or other localized lesion, together with the implicated portion of the gastric wall, the resulting scar is visible as an irregular defect which gradually becomes less pronounced. A similar result is to be expected from gastrogastrostomy for hour-glass deformity of the stomach.

Pyloroplasty: Gastroduodenostomy. Early after any of the various methods of pyloroplasty, with or without excision of lesions, notwithstanding the resulting enlargement of the gastric outlet, evacuation of the stomach is not proportionately hastened but seems to be retarded, at least during the time required for examination. The lines of suture produce irregularity of the pyloric and duodenal contours in proportion to the type and extent of operation, and to this is added the deformity caused by the lesion for which the operation was

Fig. 5. Sleeve resection. *a*. Stomach before operation; large perforating ulcer on lesser curvature with hour-glass deformity. *b*. Same case as in *a*, four years after sleeve resection; normal result. *c*. Same case as in *a* and *b* five years after operation; gastric ulcer at site of resection.

performed or by the scar resulting from excision (Fig. 7 *a*, *b*, *c*).

In the course of time the passage of ingesta through the outlet becomes quite free, although intermittent, and the gastric evacuation time is materially shortened. Deformities of contour persist but become less marked (Fig. 8 *a*).

supplementary to gastrojejunostomy or other operations, or independently. If the stoma is sufficiently high in the bowel it can be demonstrated with the barium mixture, but attentive observation is required, and to prevent obscuration of the field only small amounts of the suspension should be given (Fig. 8 *c*).

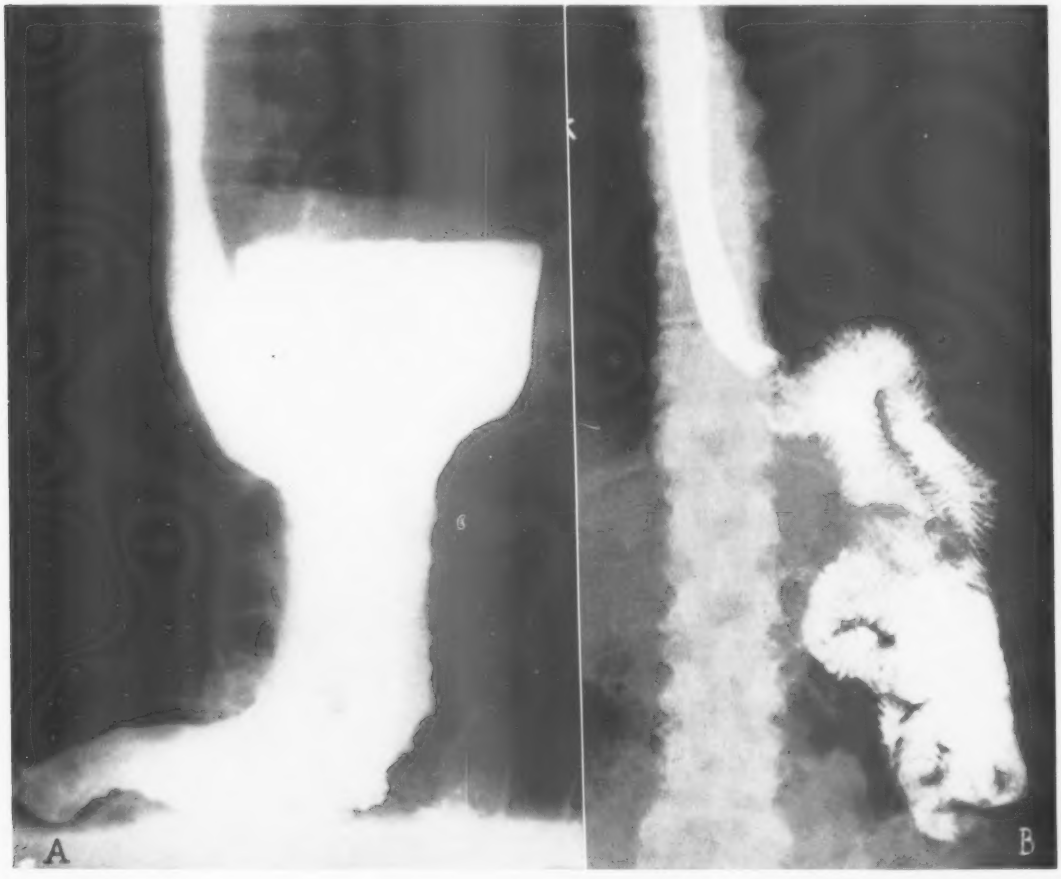

Fig. 6. Total gastrectomy. *a*. Stomach before operation; extensive scirrhous carcinoma of the stomach with an abnormally long infradiaphragmatic position of the esophagus, which facilitated total gastrectomy. *b*. Same case as *a* one year after total gastrectomy, with anastomosis of jejunum to esophagus.

Following gastroduodenostomy, near the pylorus (Fig. 7 *b*, *c*) but preserving the pyloric canal intact, the gastric contents pass through both the stoma and pylorus, but in varying ratios (Fig. 8 *b*).

Enteroenterostomy. Often an anastomosis is established between the duodenum and jejunum, or between jejunal loops, either

COMPLICATIONS AND ABNORMAL RESULTS

Complications which occasionally follow the foregoing operations include recurrence of carcinoma, recurrence or new development of gastric, duodenal, or gastrojejunal ulcer, obstruction from any of numerous causes, and untoward functional effects resulting from errors in surgical technique.

Recurring Carcinoma. The essential sign of carcinoma that has recurred after resection of the stomach is the shadow-defect produced by the tumor. To this may be added stiffening of the gastric wall, or a palpable mass at the site of the lesion, absence of peristalsis from the affected portion, local effacement of rugae by the tu-

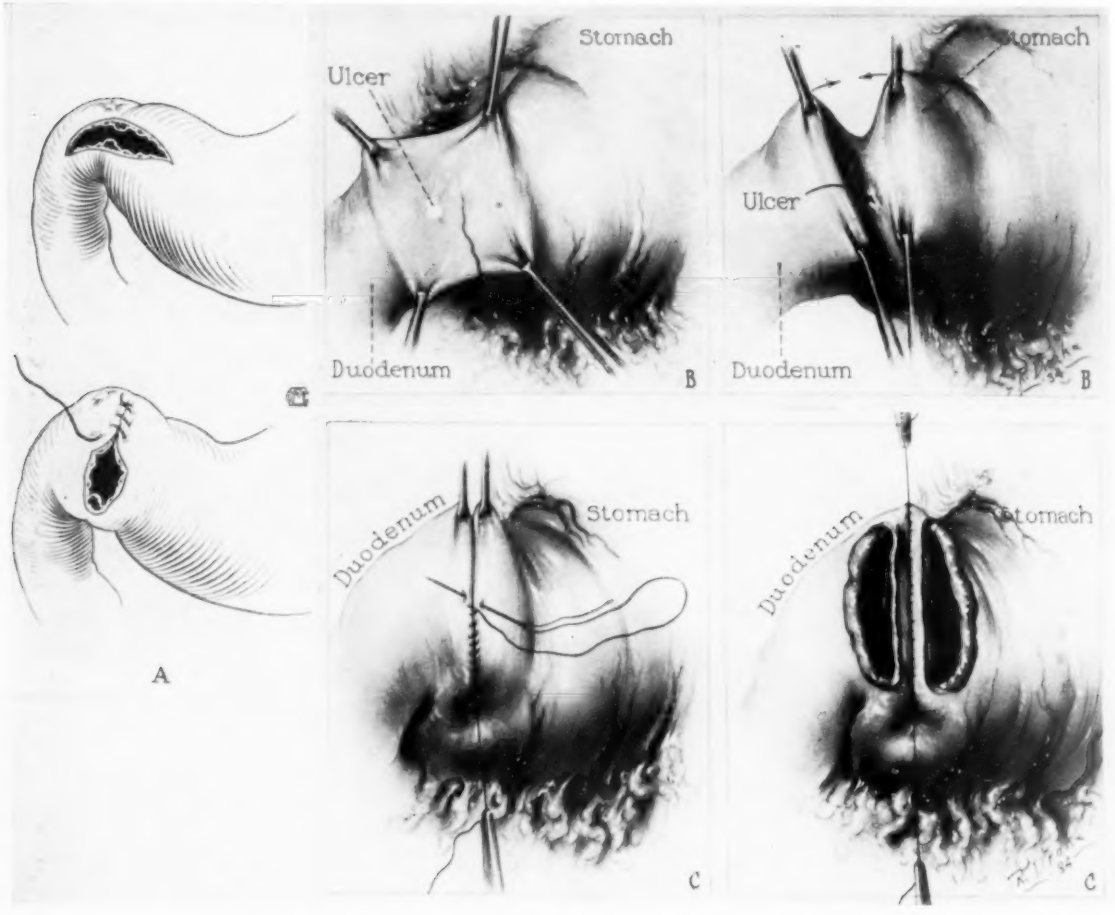

Fig. 7. Types of operation about the pylorus. *a.* Heinicke-Mikulicz pyloroplasty for duodenal ulcer. *b* and *c.* Gastroduodenostomy (Judd) at various stages of the operation.

mefaction, and perhaps obstruction at the stoma. But as the remnant of the stomach is usually not readily accessible to manipulation, some of these signs can scarcely be elicited, and the others are not diagnostic without the defect. If the new growth is small and has recurred soon after the operation, it is difficult to distinguish the defect representing it from a slight irregularity in the suture line. However, the latter deformity is usually sharply defined, whereas the defect caused by carcinoma often shades off gradually. When recurrence is gross the diagnosis is fairly obvious. On the whole, local recurrence after resection is much less common than metastasis, and when signs of recurrence are lacking or doubtful the investigation should be directed toward metastasis.

Recurrence or New Development of Gastric or Duodenal Ulcer. Exceptionally, after operation for gastric or duodenal ulcer, the lesion apparently heals but later recurs, or new ulcers develop. The direct roentgenologic signs are the same as those observed in cases in which operation has not been

performed, but are often more difficult to elicit, for in many instances the manipulation and other procedures necessary for satisfactory inspection are less easy, or impossible, to execute. Secondary signs, such as alterations of peristalsis and motility, are usually greatly modified as a result of the operation. In most cases, however, the essential sign of recurring or new gastric ulcer, the niche, is demonstrable (Fig. 5 *c*). After pyloroplasty for duodenal ulcer, with or without excision of the ulcer, persistent deformity results, and deformity follows healing of an ulcer after gastrojejunostomy.

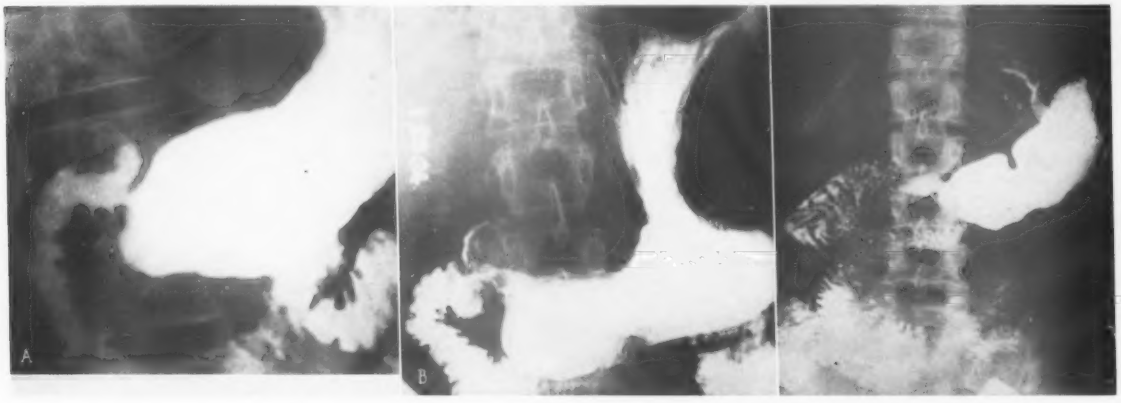

Fig. 8. *a*. Two and a half years after excision by cautery of an ulcer on the posterior wall of the duodenum, knife excision of a second ulcer on the anterior wall, and reconstruction of the pylorus. *b*. Two months after gastroduodenostomy (Judd). *c*. Duodenojejunostomy for partial nonrotation of the duodenum with stasis.

Consequently, deformity must not be construed as evidence of an active lesion unless a niche, or the irritability characteristic of duodenitis, is also present.

Gastrojejunal Ulcer and Gastrojejunitis. Gastrojejunal ulcers, which comprise not only marginal ulcers of the stoma, but also those confined to the jejunal loop, occasionally follow gastrojejunostomy. In the majority of cases they are found in the first 15 cm. of the efferent jejunal loop, especially in the first 4 cm., next most frequently at the stoma, and exceptionally in the afferent segment of the loop. Frequently an ulcer which appears to be immediately on the suture line is in fact confined to the jejunal aspect of the stoma. Usually the ulcers are of the penetrating type, occasionally they are of the perforated variety, and rarely they are shallow mucosal erosions. In a small percentage of cases the ulcer perforates into the transverse colon and produces a gastrocolic or jejunocolic fistula. Often the ulcers are associated with gastrojejunitis or jejunitis, a localized or extensive, inflammatory, edematous thickening of the mucosa, comparable to duodenitis and sometimes occurring without frank ulceration. In most cases the ulcers are single, but multiple ulcers are encountered occasionally. A majority of the ulcers are 1 cm. or less in diameter, although they sometimes attain much greater dimensions, especially those following anterior gastroenterostomy (Fig. 9 *b*, *c*).

First in importance among the roentgenologic signs is exhibition of the ulcer crater, the niche. The crater is to be sought for at the site of election, namely and in order, the efferent loop, stoma, and afferent loop. In cases observed at the clinic, niches in the stoma were more often situated on its mesial border, at the internal gastrojejunal angle, although certain other observers have found a majority on the lateral border, at the external angle. Sometimes the niche fills spontaneously with barium and is readily visible, either as a marginal projection or central fleck, but often manipulation, compression, and

careful search are necessary to reveal it. By thorough and methodical examination a niche can be demonstrated in approximately two-thirds of the cases (Fig. 9 *a*, *b*, *c*).

cosa of the stoma may be swollen, with resulting obliteration of the internal markings and more or less obstruction of the outlet. In such cases the shadow of the barium at this point often has the form of a

Fig. 9. Gastrojejunal ulcer. *a*. Perforating ulcer with crater on distal limb of jejunum; three years after operation. *b*. Perforating ulcer 3 cm. in diameter on distal limb of the jejunum, near the stoma, following anterior gastroenterostomy. The roentgenogram was made after ingestion of a small amount of barium. *c*. Same case as in *b* after filling the stomach with the barium mixture. The large crater in the jejunum is almost obscured.

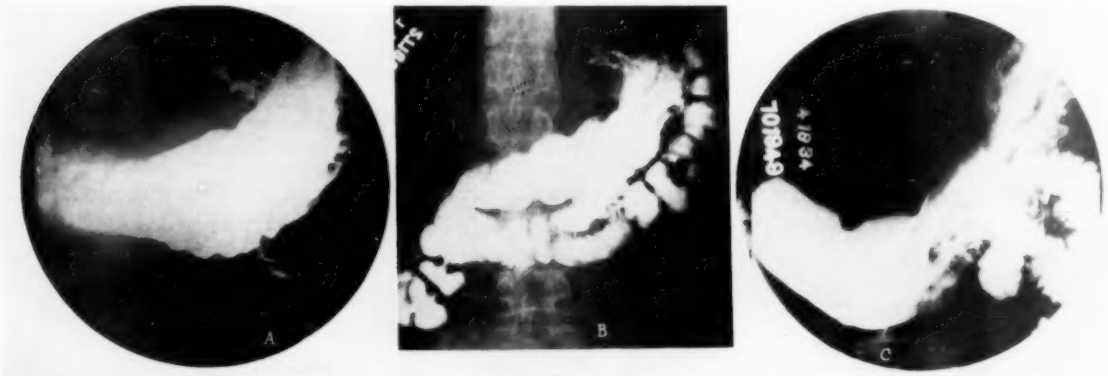

Fig. 10. Complications following gastroenterostomy. *a*. Gastrojejunal ulcer with diffuse jejunitis producing almost complete obstruction at the stoma. *b*. Perforated jejunal ulcer with gastrojejunocolic fistula. The transverse colon filled almost immediately after the suspension of barium was taken. *c*. Malfunction high gastrojejunostomy with long proximal limb of the jejunum, the knuckling of which is evident near the stoma.

Almost as significant as the niche, and commonly associated with it, is localized deformity in the ulcer-bearing area, the extent of deformity being proportionate to the extent of inflammatory reaction. If the ulcer is at the stoma, the gastric wall at this point may be deeply indented and irregular, and the rugae may be convergent and distorted. In other instances the mu-

smooth, truncate wedge or keystone. When the lesion is limited to the jejunum, the affected segment, which varies in extent, is smoothly or irregularly narrowed, and the markings of the valvulae conniventes are effaced in proportion to the degree of jejunitis (Fig. 10 *a*).

In approximately a tenth of the cases of gastrojejunal ulcer, gastrojejunocolic fis-

tula results. Sometimes the fistula is plainly demonstrable after the barium meal (Fig. 10 *b*), but more often its revelation requires employment of the opaque enema.

Among secondary signs of gastrojejunal ulcer, perhaps the most important are those of obstruction resulting from partial or even complete closure of the stoma, or marked stenosis of the jejunum. Obstruction may be manifested in retarded evacuation, dilatation, and hyperperistalsis, either of the stomach, or of the jejunum proximal to the point of stenosis. Obstruction sufficient to produce retention after six hours is rare. Tenderness over the niche or region of deformity is commonly present, and the mobility of the affected site may be lessened. Occasionally, especially when anterior gastrojejunostomy has been performed, the gastrojejunal lesion is palpable.

Sources of error in the positive diagnosis of gastrojejunal ulcer or gastrojejunitis are few. By the manipulation so often necessary to reveal a niche it is possible to pen up a fleck of barium in the valvular folds and to mistake it for a niche, but only the shadow representing the crater of an ulcer is constant in form, size, and situation. Spasm or intestinal peristalsis may produce localized narrowing of the jejunum, but such contraction changes in aspect, or moves on, and the valvulae conniventes are not altered or obliterated. Adhesions may deform or constrict the bowel, but this is rare. A small stoma may have been made so originally; in this event the internal relief is neither puckered nor smoothed out. Secondary signs, without direct evidence, are not sufficient basis for the diagnosis. Because the niche or deformity so often is small and hard to discover, some cases will escape recognition, but with experience a positive or qualified diagnosis can be made in from 75 to 90 per cent. When it is evident or probable that a gastrojejunal ulcer is present, it is extremely important to inform the surgeon as to the patency of the pylorus. At reoperation the surgeon is not always able to determine whether the pylorus is freely patent or not, and if it is obstructed, pyloroplasty may be a necessary feature of the second operation.

Gastroileostomy. Exceptionally, an inexperienced or unfortunate surgeon performs anastomosis of the stomach and ileum instead of anastomosis of the stomach and jejunum. On roentgen examination the condition is readily disclosed by almost immediate appearance of the suspension of barium in the terminal part of the ileum and ascending colon.

Obstruction. Following operation on the stomach and duodenum, notably after gastrojejunostomy, various forms of obstruction may occur. To the syndrome arising from certain varieties of obstruction, the term "vicious circle" is sometimes applied. In clinical usage, vicious circle is characterized chiefly by persistent vomiting, with more or less bile in the vomitus, and the term connotes exit of gastric content through the stoma or pylorus, with reëntrance at the other aperture. It has been aptly said, however, that although the condition is truly vicious, actual or invariable circulation of the gastric content is open to question. Among causes of regurgitant vomiting have been listed the following: kinking of the jejunal wall opposite the stoma, the kink thus forming a spur; prolapse of gastric mucosa into the stoma; closure of the stoma; acute angulation at the duodenojejunal juncture, and constriction of the jejunum by contraction of the opening in the transverse mesocolon. Other causes of obstruction include volvulus of the efferent jejunal segment, hernia of the jejunum through the opening in the mesocolon, intussusception of the jejunum into the stomach through an unduly large stoma, and adhesions.

Notwithstanding its numerous potential causes, obstruction is not common and is then most often a result of gastrojejunal ulcer. By roentgen examination the fact of obstruction and the point of arrest are readily demonstrable. The stomach or portion of small bowel proximal to the stenosis

is likely to be dilated, peristalsis is accentuated, evacuation is retarded, and retention after six hours may occur. Intussusception into the stoma, and obstructing angulation at the duodenojejunal juncture, may be identifiable, but in other cases the examiner will rarely be able to determine the cause of the obstruction.

Errors in Surgical Technique. In relatively rare instances, errors on the part of the surgeon are responsible for ill results from operation. It is generally agreed among surgeons that in performing gastroenterostomy, the stoma should be neither too large nor too small, and that it should not be placed too near the pylorus or too high on the greater curvature. If the stoma is too small or too high, its prime purpose obviously is frustrated; if too large, so-called "dumping" results with precipitant evacuation of gastric content. Likewise, it is agreed that the proximal jejunal segment should not be too short or too long, for in either event gastric drainage is likely to be impeded (Fig. 10 *c*). But between admittedly undesirable extremes in technical details, there is a wide range within which the surgeon may exercise his judgment. Further, unusual conditions may necessitate surgical methods which ordinarily would be objectionable. Consequently, although roentgen examination will demonstrate the site and size of the stoma and the length of the jejunal loop, the examiner should not too readily attribute organic complications or functional disturbances to any of these factors. He should remember, also, that after operation the patient is subject, the same as other persons, to transient disorders of the digestive tract, and that these may be responsible for abnormal roentgenologic manifestations.

In short, the attitude of the roentgenologist toward the surgeon should be cooperative rather than critical. Few roentgenologists have had sufficient experience with the stomach and duodenum after operation to allow them to form definite conclusions as to preferable types of operation, or to justify their making final decision as to success or failure in a given case. Obviously roentgen examination affords the most practicable and most informative method of studying functional behavior after operation, and the surgeon can profit from the information gained thereby. His judgment should also be taken into account in determining whether results are good or bad, and the reasons therefor.

DISCUSSION

Dr. E. P. Pendergrass, Philadelphia. It is always a great pleasure to hear Dr. Kirklin present a paper because of the thoroughness with which his papers are prepared. My efforts, therefore, will have to be those of emphasis on some of the points that he has already mentioned, and a discussion of my experience with such examinations.

It is absolutely essential that the roentgenologist be familiar with the surgical technique employed in a given case, the duration of symptoms before and after operation, and the nature of the condition for which the patient was operated on. The technique should be different for the recently operated cases and those in which the interval between operation and the roentgen examination is several months to several years.

In both groups of cases the examination should be on an empty stomach. This is exceedingly difficult to obtain in the recently operated case, because of the presence of a nonopaque residue, due either to gastric secretions or retained food, or both. In order to obviate the pressure of food we recommend a light supper, and no breakfast, and make the examination in the morning, usually sixteen hours after the last meal.

In the older operated group the examination is made five to six hours after fasting.

As a nonopaque residue prevents adequate delineation of the mucosal coats with the opaque meal, it may be necessary to wash the stomach out before the roentgen examination.

The normal emptying of the gastroenterostomy is important and my observations have been similar to those of Dr. Kirklin. I have been impressed by the delay in motility of re-

cently operated stomachs (gastroenterostomy), a residue often being present for twelve to twenty hours. Unless such an observation is known, errors in interpretation may result. Yet these patients are always hungry. Why is it?

Cannon and Blake have shown that rhythmic contractions of the jejunum prevent the rapid emptying of the stomach, and intermittently allow food to pass into the jejunum. Dr. Johnson, of the Surgical Research Division of the University of Pennsylvania, and I have convinced ourselves that in dogs this observation is true.

Another factor that has to do with emptying of the stoma is the nature of the food. Increase in alkalinity and other factors, or acidity, will prevent normal emptying of the stomach. Anyone who may be interested in this phase of the subject is urged to read the paper published by Gianturco. Addition of 50 per cent glucose to the barium meal will materially delay the emptying time of the stomach. Dr. Charles Johnson, in a study of the small intestinal contents of 50 dogs, found only 1 dog in which the small intestinal contents were not approximately isotonic or lower. This seems to confirm the observations of Shea and Cohen who state that the emptying of the stomach is controlled by the small intestines.

We have found that contents leave the stomach by the pylorus and the stoma when the former is not blocked. I would like to ask Dr. Kirklin if he has observed that the duodenum is more dilated after operation in cases in which the pylorus is not blocked, and if so, if he can explain it. We have noticed this and Dr. Johnson tells me that it is the usual finding in the operated dog. Could a reversal of the duodenal gradient account for this?

There is another question that I would like to ask Dr. Kirklin. Why does the stomach following gastroenterostomy become smaller and empty slower than a stomach in which a Pólya operation is performed. In the latter, in my experience, the stomach empties much faster than the stomach with a gastroenterostomy and although it empties faster it is usually larger, even though both stomachs were approximately the same size before operation.

My experiences with the other operations described by Dr. Kirklin are similar to those that he has reported.

In cases of carcinoma of the stomach that are operated upon, I recommend a routine film in the erect and prone postures four weeks after operation. This gives the (control) appearance before a possible recurrence can develop and after inflammatory changes have disappeared. The possible diagnosis of recurrence is rendered easy at any subsequent time because it will show the gradual contraction of the lumen of the stomach.

The occurrence of jejunal or gastrojejunal ulcers occurs rarely following gastroenterostomy when there is a pyloric obstruction that is complete or almost complete. I think surgeons should keep this in mind when considering the type of operation to be employed in a given case.

I again would like to congratulate Dr. Kirklin upon his excellent presentation, and urge with him that roentgenologists pay more attention to the operated stomach and try to learn something of its physiology. There is still a large field for further investigations.

Dr. Merle R. Hoon, Pittsburgh, Pa. It is a fair request on the part of the roentgenologist to have reliable data in his possession when examination is made of the stomach and duodenum, previously operated upon. These data should consist of the pathology found at the previous operation, the type of operation performed, the interval since operation and the symptomatology.

The pathology report given him must be not only the gross pathology but also the microscopic examination. In no field of surgery are mistakes more frequent than in the differential diagnosis of benign and malignant lesions of the stomach. No surgeon, regardless of the extent of his experience, should rely on the gross appearance of a gastric lesion. No gastric lesion should be treated surgically without microscopic examination of a specimen by a competent pathologist. Consequently the pathologist's report must be given to the roentgenologist.

Adhesions as a result of operative procedure will vary with the type, extent and the presence or absence of infection, etc. It is a fair request of the roentgenologist for all details as to these.

As to symptomatology, comparison of the type before and after the previous operation is highly important and of great assistance in interpreting our findings by roentgenoscopic examination and interpretation of roentgen films. The pain of a gastrojejunal ulcer usually occurs earlier after eating than in the case of recurrence of a pre-existing peptic ulcer, located in the duodenum or stomach proper.

Dr. Pendergrass has discussed the technique of examination, of which I have no knowledge. There is a sense of satisfaction to the surgeon that results will be disappointing when examination is made relatively soon after operation. Someone has said "There is luck in leisure." Surely this is true, for the adequate reasons as presented by Dr. Kirklin. Surgeons are, and always will be, grateful for assistance in the recognition and diagnosis of complications and abnormal results following the types of operation as presented today. No surgeon desires to perform a secondary, so-called exploratory, laparotomy. Preoperative recognition of a complication always shortens the time of the operation in the surgical treatment of the complication. Unnecessary exploration and freeing of adhesions will be avoided. The operative risk is hereby decreased. A non-patent pylorus associated with a gastrojejunal ulcer warns the surgeon that a pyloroplasty will be necessary in addition to resection of the gastrojejunal ulcer and the operation will be planned in advance.

As a surgeon, may I express my appreciation to the roentgenologists for their help in the development of modern gastrointestinal surgery. I speak the gratitude of all the surgeons. We appreciate your cooperation. We know your criticisms of our work, as revealed by roentgen examination, are constructive criticisms and never destructive.

Dr. W. H. Stewart, New York City. It is often very difficult roentgenographically to detect a gastric lesion in a stomach which has sustained surgical interference. Since we have been using the mucosal pressure method we have been able to pick up many cases of marginal ulcer after gastroenterostomy which otherwise would have been overlooked.

The question of patency of the stoma is often referred to the roentgenologist by the surgeon. Do not attempt to give any information on this point unless you have used a motor meal. Zoolack and barium will pass quickly out through the gastroenterostomy opening even when marked contraction has occurred. The normal emptying time, if such a term may be used, varies with each case. As a rule three and a half to four hours is required.

Dr. Kirklin (closing). I am very appreciative of the interesting discussions. I fear that I cannot answer Dr. Pendergrass' question as to why the duodenum appears larger following gastroenterostomy, because in our experience this has not been observed. We do not examine a large number of patients immediately following operation. Most of them are seen when they return from one to three or more years later.

I think the reason that the stomach empties more quickly following the Pólya resection is the fact that there is a much larger stoma, and, of course, there is less stomach, so that the meal goes almost directly into the small bowel. Dr. Stewart has suggested that a normal emptying time be established for the gastroenterostomized stomach. I think this would be very difficult to do in view of the fact that the emptying time depends on many factors, including the type of operation that has been done, the size of the stoma, etc. It has been my observation that every surgeon performs a slightly different type of operation, and although the emptying time may vary, the end-result may nevertheless be quite satisfactory. However, I feel that the maximum emptying time for a carbohydrate meal should not exceed two hours.

INTERPOSITION OF THE COLON FOLLOWING INDUCED PHRENIC PARALYSIS*

By PAUL SLAVIN, M.D.
GLEN GARDNER, NEW JERSEY

PHRENIC interruption causes rise of the paralyzed hemidiaphragm into the thorax and increases the capacity of the peritoneal cavity. The abdominal viscera adjust themselves within an enlarged space, and their anatomical arrangement may undergo certain changes.

Displacements of portions of stomach and esophagus, resulting from induced phrenic paralysis, have been observed clinically and in experimental studies.[2] In the extensive literature on phrenic nerve operations and their complications, no reference is found to displacement of the intestinal tract, known as interposition of colon, and consisting in detachment of the right hemidiaphragm from the liver, with enclosure of intestinal loops between them.

In our series of 141 right phrenic exclusion cases the paralyzed diaphragm receded from the liver in two instances. In one of them a portion of the colon became permanently lodged within the vacated phrenic vault, and in the other a probable temporary interposition of colon took place.

CASE 1 (No. 12752). R. D., male, aged twenty-six, admitted to the New Jersey State Sanatorium August 22, 1932. Present illness began January 14, 1932, with hemoptysis, and was diagnosed as pulmonary tuberculosis two months later. Under treatment by right-sided artificial pneumothorax for the last five months. Except for an occasional emetic cough patient did not complain of gastrointestinal disturbances, and past history contained no suggestion of abdominal ailments. Roentgenograms taken prior to induction of pneumothorax and on admission to Sanatorium showed the right dome of the diaphragm to be confluent with liver in one continuous opaque shadow (Fig. 1).

On bed rest and pneumothorax treatments patient gained 10 pounds in weight within eight months, his general condition improved, but sputum continued positive for tubercle bacilli. Upper lobe of right lung, held by adhesions to chest wall, still contained non-compressed small cavities. To facilitate closure of those cavities, a right phrenicectomy was added to continued pneumothorax. Two days after operation a roentgenogram showed paralyzed hemidiaphragm elevated 3 cm. and not separated from liver surface.

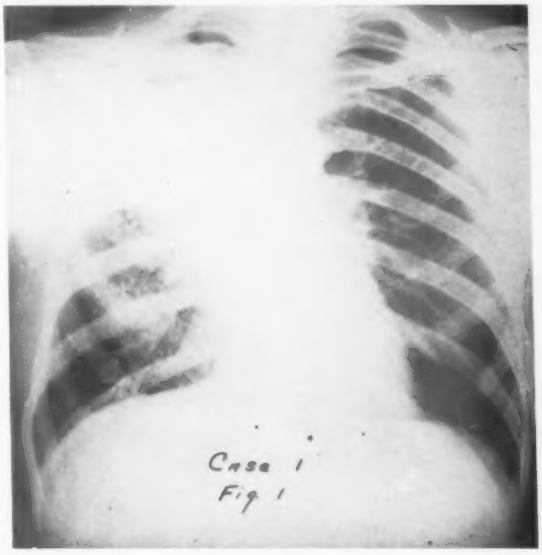

FIG. 1. Case 1. Before induction of artificial pneumothorax. Massive tuberculous involvement of the right upper lobe. Right dome of the diaphragm confluent with liver shadow.

There were no postoperative alimentary disorders, the emetic cough ceased, and patient continued to gain in weight. A better collapse of the treated lung was attained and tubercle bacilli began to disappear from sputum. Three months after the operation, the right dome of the diaphragm appeared on the film as a convex linear band, elevated 6 cm., overshadowing in its outer third the pneumothorax space, and in its inner two-thirds the compressed lower lobe. Beneath the diaphragmatic arch, in place of the liver shadow, lay a collection of gas, 2 cm. high, intersected by irregular septa (Fig. 2). A barium enema showed the rarefied subdiaphragmatic area to be a portion of colon.

* From New Jersey Sanatorium for Tuberculous Diseases, Glen Gardner, N. J. Dr. S. B. English, Medical Director.

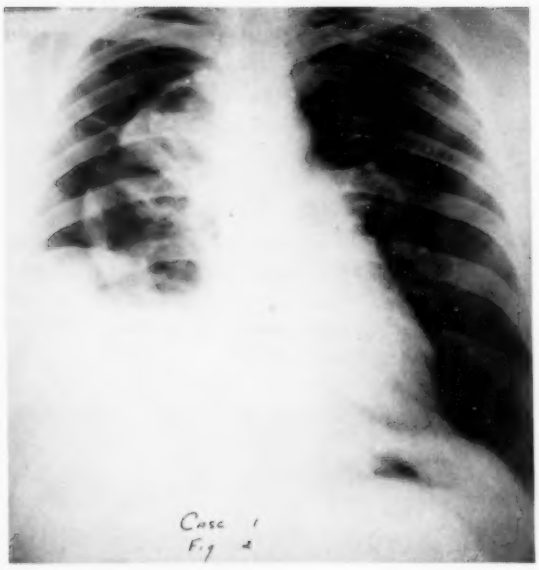

Fig. 2. Case 1. Right lung compressed toward its root by artificial pneumothorax. Right dome of the diaphragm detached from opaque liver shadow.

Figure 3 presents the barium-filled large intestine. The ascending colon rises to the under surface of the paralyzed diaphragm, where it forms a loop, the top of which extends transversely within the right subphrenic space for a length of 10 cm. Doubling on itself downward for a distance of 15 cm., the ascending colon terminates at the hepatic flexure in the transverse colon. The ascending colon rises 21 cm. higher than the descending. The paralyzed diaphragm is elevated 12 cm.

DIFFERENTIAL DIAGNOSIS

The condition was recognized chiefly by the roentgen findings. There were no symptoms referable to the right hypochondriac region. The patient is overweight, free from toxic manifestations, and able to exercise liberally. The abnormal signs on percussion were: anteriorly—diminished resonance over area of usual hepatic flatness; posteriorly—abdominal tympany in right infrascapular region, from 9th rib downward. Interpreted in the light of an air-filled pleural cavity and an elevated diaphragm, those signs are of little diagnostic assistance.

Roentgenologically, the collection of gas between liver and diaphragm could have been mistaken for a part of the treated lung, a pneumoperitoneum, a subphrenic gas abscess, or a diaphragmatic hernia.

The contour of the partly compressed three lobes can be traced on the roentgenograms, and does not blend with the translucent shadow.

Pneumoperitoneum, incidental to artificial pneumothorax, is likely to be produced in a phrenicectomy case by injecting air below the level of the elevated diaphragm. Instances have also been reported of indirect pneumoperitoneum,[3] produced by air passing from pneumothorax space into abdominal cavity, through one of the openings in the diaphragm. The field of a subphrenic pneumoperitoneum would not be traversed by bands; the outline of the liver would be accentuated. Free air in the abdominal cavity, when present for a long time, would spread to the contralateral subphrenic vault, and would also show variations in its volume in the intervals between refills.

Absence of a septic state excludes the

Fig. 3. Case 1. Barium-filled large intestine. Additional loop of ascending colon.

possibility of a gas abscess, or of air entering from a ruptured viscus.

By their resemblance to haustrations, the septa in the rarefied area furnish a decisive differential fact. Finally, the diagnosis is confirmed by a contrast medium in the large bowel, and if necessary, also in stomach and small intestines.

Diaphragmatic herniations are ruled out by the intactness of the diaphragmatic contour.

PATHOGENESIS

Wessler and Jaches[9] mention interposition of the colon as one of the pathological features, resulting from downward displacement of liver, in eventration of the right diaphragm and in hepatoptosis.

Pendergrass and Kirk,[6] discussing significance of gas in the right subphrenic space, report an instance of interposition, secondary to complete dislocation of liver from its usual position.

Altschul,[1] commenting on a case reported by Cave,[4] attributes temporary interposition to weakness of the diaphragm and terms the morbid condition "diaphragma molle."

Podkaminsky[7] regards interposition as an expression of pathological intra-abdominal pressure. Among the causes, he lists changes in size of liver; adhesions between it and stomach, resulting from parapyloric ulcer; weakness of hepatic ligaments; hepatoptosis; diastasis of abdominal muscles; diminution of thoracic suction by emphysema; megacolon. In each instance various causes are present in various combinations.

Uspensky,[8] presenting his observations in 22 cases, subdivides interposition into temporary and permanent, the latter form being confirmed by demonstration of adhesions between colon and adjacent organs. As causes of permanent displacement, he considers: pleuro-diaphragmatic-peritoneal adhesions; adhesions of pericolitis and perigastritis; Hirschprung's disease; changes in form and size of liver due to degenerative processes. Temporary interposition he believes to be due to disturbances of balance between specific gravity of liver and that of colon, as in ascites and pneumoperitoneum. Among the factors leading to temporary interposition he includes meteorism; ascaridiasis in children; affections of diaphragm (toxic and hysterical paresis). A combination of several causes is generally present in each instance. Absence of any one of the enumerated factors does not preclude formation of interposition, while presence of those factors does not lead necessarily to appearance of the anomaly.

Just,[5] reviewing the literature on the subject, regards interposition as a disease entity, due to a primary anomaly of the bowel itself. He contends that all reported cases possessed an abnormally enlarged and elongated colon, endowed by high mobility. In a state of distention and increased peristalsis a long, very mobile colon may force its way into the right subphrenic space. The upward drive of the ascending colon acts then in a manner comparable with separation of the liver from the diaphragm by free air admitted into peritoneal cavity. Other morbid conditions met with in interposition he considers to be predisposing causes only.

The sequence of events in our case shows that interposition developed following phrenic paralysis. The probability of additional predisposing factors being present is suggested by the rarity of this complication in therapeutic phrenicectomy. In 139 out of 141 patients with right phrenic exclusion, the liver continued to rest against the paralyzed diaphragm at high levels of elevation. Evidently the forces that maintain contact between liver and diaphragm during respiratory excursions remain competent also after paralysis of the right diaphragm. Normally, the equilibrium of the liver is controlled and its descent prevented by several forces: (1) thoracic suction (elastic pull of lungs); (2) tonicity of intestinal walls and abdominal muscles; (3) upward pressure within the intestinal tract; (4) atmospheric pressure outside the abdominal walls; (5) capillary cohesion. To some extent the liver is

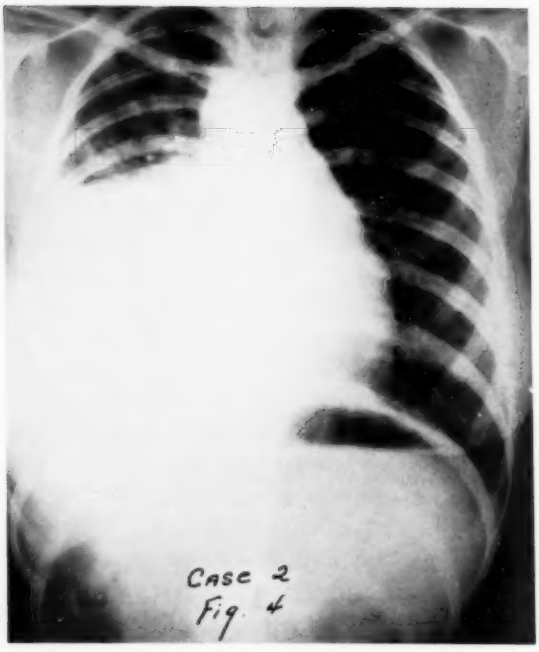

Fig. 4. Case II. Right phrenic paralysis. Detached right dome of diaphragm.

being sustained also by its anatomical attachments. Suppression of any of these forces weakens the contact between liver and diaphragm and facilitates their separation. In the case presented, one of the enumerated forces, the elastic pull of the right lung, was compromised by artificial pneumothorax. It might be added here that among the 141 patients 53 have been treated by phrenic exclusion combined with pneumothorax, preliminary or subsequent, and only in 2 of them did the liver fall away from the diaphragm.

Whether there were more factors accountable for the reported interposition is not certain. The capacity of the colon is not increased, judging by the amount of barium mixture necessary to fill it. On the film the transverse colon seems to be rather shortened. The loop under the right dome of the diaphragm constitutes a portion of the ascending colon, as indicated by the similarity in their haustral segmentation. The redundancy of the ascending colon might have developed, however, in response to the drawing force of the vacuum between the separated diaphragm and liver.

TREATMENT AND PROGNOSIS

No treatment is necessary in the absence of morbid manifestations. There is a constant danger of the displaced viscus becoming incarcerated, and the patient should be aware of the existing displacement and its possible complications. When symptoms of obstruction develop the condition becomes a surgical problem. Whether return of diaphragmatic function and reexpansion of the treated lung would restore the normal position of the colon remains a matter of conjecture. Paralysis of the diaphragm cannot be undone in our case, as the phrenic nerve was removed by evulsion. The state of the tuberculous lesion does not warrant immediate reëxpansion of the treated lung. The interposition is known to have existed continuously for the last nine months and may be considered as a permanent displacement.

In a search among the roentgenograms for similar displacements another instance

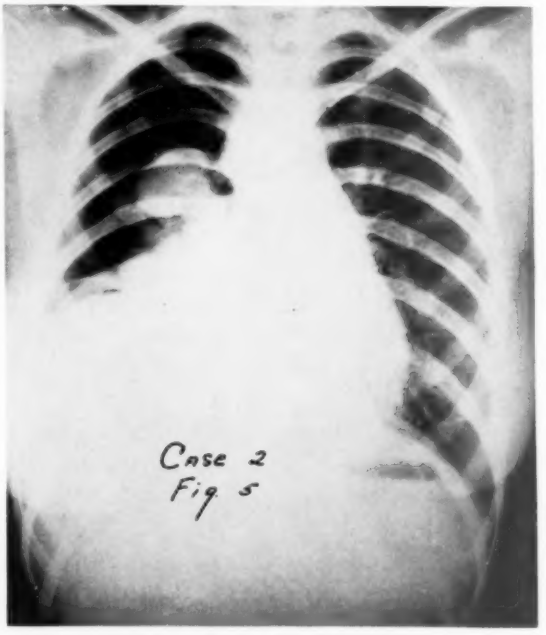

Fig. 5. Case II. Right lung compressed by artificial pneumothorax. Right dome of the diaphragm separated from liver shadow by a sickle-shaped bright area.

was revealed of a detached right hemidiaphragm.

Case II (11736). T. Y., female, aged thirteen, admitted to the Sanatorium, December 12, 1930. Eleven months later a phrenicectomy was performed for the treatment of a basal tuberculous lesion in the right lung. There has been gastrointestinal disturbances before and after operation, with flatulence, vomiting, and loss of weight. Roentgenograms on admission, before operation and immediately after, showed the right dome of the diaphragm confluent with the hepatic shadow (Fig. 4). Eleven months after operation the paralyzed diaphragm rose to the level of the third rib anteriorly and appeared as a slightly convex linear band, separated from the liver shadow by a translucent area. At this time artificial pneumothorax was induced on same side, as a supplementary treatment. Roentgenogram taken after three injections showed 80 per cent collapse of the right lung. The diaphragm was displaced downward to level of fourth anterior rib. The outer half of the dome was separated from liver by a gas collection, 1 cm. high, the inner half by a narrow slit only. No haustrations visible in the area between liver and diaphragm (Fig. 5). The condition was not recognized at that time and not verified by contrast medium in the intestinal tract. Patient was transferred to another sanatorium, November 25, 1932. Last roentgenogram taken in March, 1934, showed paralyzed diaphragm again in contact with liver.

In this case the diaphragm began to recede from liver after evulsion of the right phrenic nerve, and the separation was augmented by artificial pneumothorax. The outstanding differential point is derived from the fact that detachment of the diaphragm occurred before induction of pneumothorax, when no air could have been injected into peritoneal cavity. Haustrations may not be visible in an anteroposterior view. This case is to be considered as one of probable temporary interposition.

SUMMARY

Two instances of interposition of the colon complicating right phrenicectomy in the treatment of phthisis have been presented. Differential diagnosis, pathogenesis, and treatment are discussed. Interposition is apparently caused by a combination of various morbid factors. An important part is played by phrenic paralysis. Rise of the paralyzed diaphragm creates a vacant space within the abdominal cavity and may lead to dislocation of various viscera, including the large intestine. Evidently the contractions of a functioning diaphragm are able to force back an encroaching colon, while this resistance is lost by a paralyzed diaphragm. Right-sided artificial pneumothorax, by compromising the elastic pull of the treated lung, weakens the contact between liver and diaphragm and facilitates their separation. A probable significant factor is an abnormal elongation of the colon.

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ROENTGENOGRAPHIC EVIDENCE IN THE TUBEROSITY OF THE HUMERUS OF RECENT AND OLD INJURIES TO THE SUPRASPINATUS TENDON ATTACHMENT*

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IT IS not my purpose to discuss the frequency of supraspinatus tendon injuries or the clinical diagnosis and symptoms, which have been so thoroughly covered by Codman. The importance of this injury in industrial accident cases cannot be too greatly emphasized. The possibility of demonstrating the lesion roentgenographically should not be overlooked. A simple technique for this purpose is described below.

In 1927 following the roentgen examination of a patient with persistent serious symptoms (disabling pain) following an injury one year previously, my attention was drawn to a considerable amount of bony proliferation of the tuberosity of the humerus. Becoming interested in this subject I have given it special attention since that time.

In 1906 Codman first described what he at that time called "subdeltoid bursitis,"[2] but what he in his later reports designates as "supraspinatus tendon injuries." He states that roentgenographic examinations in the acute cases are invariably reported negative, and no mention has been made by him or other writers of the roentgenographic evidence in chronic injuries, in any published reports. Carnett[1] in his excellent report on "So-called calcifying subacromial bursitis," states in passing that his special technique is far superior to stereoscopic films for detecting bursitis deposits, but the stereoscopic films are helpful in proving "that a given shadow is attached to the bone." It is "the shadows attached to the bone," which this study covers.

On reading Codman's article entitled "Rupture of the supraspinatus tendon,"[3] in which he so well describes the serious consequences of this injury together with its frequency, and the article by Codman and Akerson[5] on "The pathology associated with rupture of the supraspinatus tendon," both published in 1931, I felt that roentgenographic demonstration of evidence of these injuries would be a real contribution to the study of this important lesion.

As a result of more or less intensive study of roentgenograms obtained in a general practice without the advantages of research facilities, I have arrived at the conclusion that there is definite roentgen evidence of laceration and evulsion of the supraspinatus tendon attachment in old cases and frequently some evidence in recent cases.

The recent injury is characterized by very fine spicules of thin bone or loosened periosteum projecting from the tuberosity, when seen in relief. Occasionally a thin disc of bone is seen representing the evulsion of the whole attachment site. These changes are essentially the same as may be produced at the point of laceration or evulsion of any tendinous attachment, in any part of the bony skeleton. There is a rapid atrophy or loss of density of the trabeculae beneath and near the point of separation and then the appearance of irregular areas of increased density. "In old cases there are three signs which indicate that rupture has taken place. One is atrophy of the trabeculae beneath the base of the bursa so that the region of the tuberosity is more diaphanous. Another is the appearance of irregular osteitis about the sulcus and the top of the tuberosity. This is due to impingement of the tuberosity on the acromion as the patient endeavors to elevate his arm. A third, in very

* From the Department of Roentgenology of the General Hospital of Syracuse.

old cases, is a gradual disappearance of the sulcus, because the tuberosity is slowly absorbed so that the outline of the articular head is coincident with the outline of the tuberosity" (Codman).[4]

The evidence in older injuries (Figs. 4–8) is characterized by bony proliferation and atrophy of the tuberosity prominences. There is in such cases an abnormal roughening (or osteitis) of the greater tuberosity with marked increase in density of the surface of the tuberosity and at times small, dark, cyst-like areas (1–2 mm. in diameter) are distributed about the region of the tuberosity. These roentgenographic changes are also an exact illustration of those described by Codman and Akerson[5] from autopsy material.

Inasmuch as a careful survey of the literature fails to reveal that any attention has been given to the manner of obtaining the roentgenographic evidence of this injury, a brief report of the very simple technique would seem to be in order.

TECHNIQUE

It is my custom to obtain a history of the injury and personally to make a careful local clinical examination in all shoulder cases, noting limitations of motion, pain from motion and points of tenderness. By this examination I decide whether to make films of both shoulders for comparisons, stereoscopic views or other special views for special indications. In all cases presenting the characteristic symptoms of limitations of abduction and external rotation, with tenderness over the tuberosity, I make stereoscopic anteroposterior views, with views of the other shoulder for comparison, if there is any doubt in the findings on the injured shoulder. These films are made with a soft tissue technique. The arm is placed in adduction and complete external rotation. This throws the greater tuberosity in relief, so that the site of the insertion of the supraspinatus tendon can be studied minutely for very slight changes which may be present. These are also revealed by careful study with a good magnifying glass, in the case of acute injuries, where the quantity of bony spicules torn loose may be minute.

The proliferations of the tuberosity resulting eventually from the bony healing of the acute injury are more easily demonstrated, in the cases of the older injuries. The views of the opposite shoulder are made for comparison, to rule out anatomical irregularities of this region, which may

Fig. 1. Case 1. Film five days after injury shows typical acute injury findings.

simulate these changes. The most distinguishing characteristic in the later cases between the anatomical irregularities and the pathological changes is the change (usually an increase) in density of the surface and decrease in density beneath the surface of the bone. The dense proliferation and the "small cysts" described by Codman[3] occasionally observed in the pathological cases of long standing are also shown. The following cases serve as characteristic illustrations of the lesions:

Case 1 (Fig. 1) demonstrates typical findings in an acute injury from fall on the shoulder a few days previously. This film reveals the definite loosening of the surface of the tuberosity, with fine bone spicules protruding from the surface. Figure 2 is an enlargement of the immediate area of the tuberosity, more clearly demonstrating the lesion.

Fig. 2. Case I. Enlargement of the immediate area of the tuberosity of Figure 1 to better demonstrate the pathology.

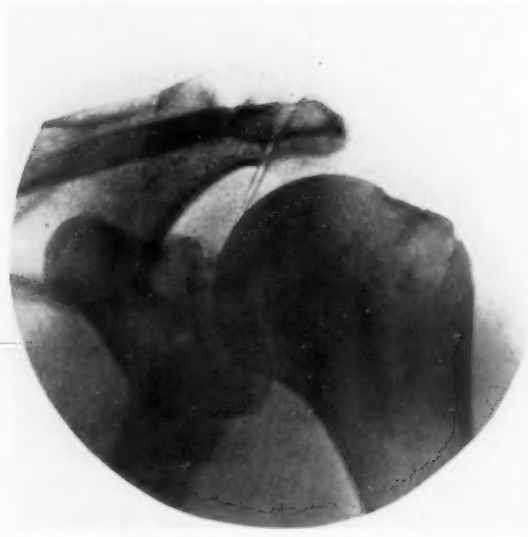

Fig. 3. Case II. Film made two weeks after injury shows practically no visible roentgen evidence of injury.

Case II (Fig. 3) is a roentgenogram of an injured shoulder made October 29, 1931, two weeks after an injury, showing scarcely detectable evidence of acute injury. Figure 4, made on December 8, five weeks later, clearly demonstrates the early changes which took place in the tuberosity in that time.

Case III (Fig. 5). This roentgenogram, made on February 26, 1934, illustrates changes which had occurred in the six weeks following injury on January 12. The irregular density upon the surface of the bone involving the sulcus and the site of the tendon insertion is very characteristic of this stage. Note the absorption of calcium in the trabeculae beneath this region, involving almost the whole of the greater tuberosity but not the head to any great extent.

Fig. 4. Case II. Film of same case made five weeks later than Figure 3. Chronic changes now clearly visible. Irregular density and atrophy of trabeculae.

Fig. 5. Case III. Film shows changes after interval of six weeks following injury. Irregular osteitis about the sulcus and atrophy of the trabeculae.

Fig. 6. Case iv. Film demonstrates changes present six months after injury, showing bony proliferation and atrophy and rounding off of the tuberosity and loss of the sulcus.

Fig. 7. Case v. Film made one year after injury. This clearly shows the small cyst-like areas. Note atrophy and irregular density of the tuberosity and ill-defined sulcus.

Case iv (Fig. 6). This roentgenogram, made December 5, 1926, illustrates changes which have occurred in a shoulder since June of the same year, i.e., six months previously. Here the sulcus is lost, the trabeculae rearranged and proliferation has occurred with the formation of a spur probably in old callus. The rounding off of the tuberosity is very striking.

Case v (Fig. 7). This roentgenogram illustrates changes present one year following injury. It clearly defines the small cysts described by Codman. Smoothing off of the tuberosity and atrophy are also visible.

Case vi (Fig. 8). This is a roentgenogram of the normal right shoulder and Figure 9 of the injured left shoulder. These films were made

Fig. 8. Case vi. Roentgenogram of the normal uninjured right shoulder.

Fig. 9. Case vi. Roentgenogram of injured left shoulder eight years after injury. This patient has never been able to raise the arm above the shoulder level since the accident. Note smooth tuberosity and irregular density.

eight years after the accident. This patient has never been able to raise the arm above the level of the shoulder since the accident. The pathology, although not extensive, is clearly visible as atrophy and irregular density, rounding off of the tuberosity and a shallow sulcus.

DISCUSSION

Case I unquestionably demonstrates the findings occasionally encountered in the acute cases, but even this much evidence may not be found. Case II clearly reveals the injured tuberosity without marked changes present, then later with unmistakable changes present. A comparison of these two films very clearly illustrates positive evidence present of the changes which have resulted from the injury, which were not present six weeks before. This illustrates the value of follow-up examinations. The remaining films present chronic changes at varying lengths of time following injury in patients with definite clinical evidence of supraspinatus tendon lesions.

It is my feeling that many cases of undiagnosed shoulder disability are from this cause, and that the roentgenographic evidence here presented should be an aid in helping to establish proper diagnosis.

SUMMARY

(1) A review of the literature does not seem to reveal a satisfactory technique for demonstrating the evulsion of the supraspinatus tendon from the greater tuberosity of the humerus, or that the subject has even been discussed by roentgenologists.

(2) Soft tissue roentgenographic technique using anteroposterior views with the arm in adduction and complete internal rotation reveals the site of insertion of the supraspinatus tendon in silhouette upon the humerus.

(3) The pathological findings follow exactly the anatomical descriptions by Codman and others. They are as follows (illustrated by six typical cases):

(a) Immediately after injury fine spicules of bone near or upon the periosteal outlines of the greater tuberosity at the site of the insertion of the supraspinatus tendon insertion.

(b) Within a few weeks irregular decreases and increases in density of the evulsed surface and rounding of the tuberosity.

(c) Six months to a year, irregular calcification and occasionally cysts with loss of the tuberosity prominence and disappearance of the sulcus. Old lesions may also show proliferation of bone in old callus together with loss of the tuberosity prominence (in this view), loss of the sulcus and rearrangement of the trabeculae in the whole tuberosity and somewhat in the adjacent parts of the head of the humerus.

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CERTAIN ASPECTS OF ROENTGENOLOGY OF THE SPINE FROM THE ORTHOPEDIC VIEWPOINT*

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THIS is not a comprehensive presentation of the roentgenology of the spine from the orthopedic standpoint. Rather, I have selected a few points which I thought might be of general interest for discussion, and I make no pretense of covering even these few points exhaustively.

First, I have elected to say a few words about anatomical variations and congenital deformities of the spine, as encountered in the roentgenological service of an orthopedic hospital. To understand these, a hasty survey of the development of the spine is in order.

In early embryonal life, the neural tube and notochord are enveloped by a continuous sheath of mesodermal tissue which forms the membranous vertebral column. The cells nearest the intersegmental arteries, which enter the column of cells at approximately the centers of the future vertebral bodies, develop more rapidly than the cells farther away from the blood supply. These rapidly growing cells encroach upon the notochord, and in consequence it is atrophied in these regions, or extruded from these parts, remaining only in the intervertebral portions of the spine, and forming eventually the nucleus pulposus of the intervertebral discs.

Chondrification of the mesodermal tissue which is destined to form the vertebral bodies, arches, and processes takes place, and the cells of the intervertebral region come to resemble fibrocartilage. A number of ossification centers appear in each vertebra, and these centers fuse with each other at various stages of embryonal life and early childhood. Failure of appearance of these ossification centers, or their maldevelopment, or their failure of fusion, explains most of the anatomical variations and congenital deformities found in spines. Failure of proper segmentation explains other deformities encountered. The development of the vertebral bodies in many cases, if not in all, from two laterally placed centers of ossification affords an explanation of the hemivertebra so frequently seen, one of the centers being absent.

The first group of cases is to illustrate the commonly encountered congenital deformities of the spine (Figs. 1–7).

Figures 8 and 9 are introduced to call attention to a particularly valuable projection of the lumbosacral region, used routinely by some roentgenologists to supple-

FIG. 1. Multiple congenital deformities of the dorsal spine.

* Read before the New York Roentgen Society, April 16, 1934.

Fig. 2. Congenital deformities of the upper dorsal spine, producing severe scoliosis.

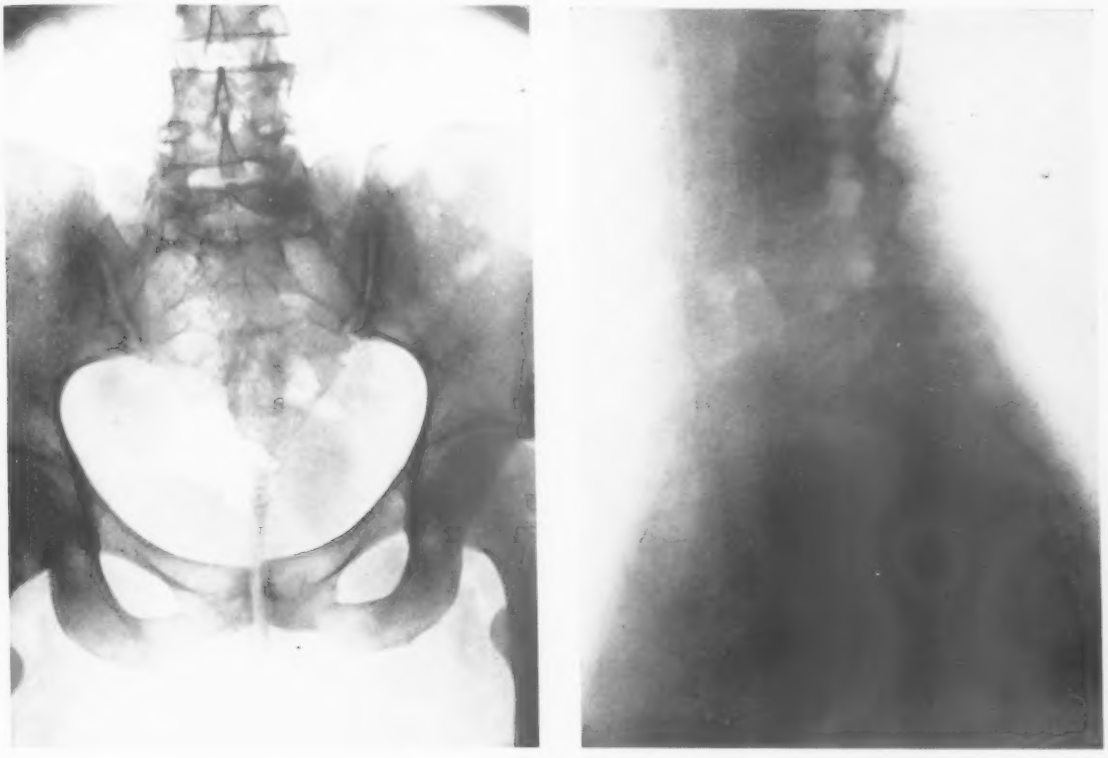
ment the anteroposterior and lateral views, but not having the widespread use which its importance deserves. This is the so-called 45° anteroposterior view, devised by Dr. Albert B. Ferguson, roentgenologist to the New York Orthopedic Hospital. And in passing, I wish also to give credit to Dr Ferguson for originating the method of measuring scolioses described in a later section of this paper, and for originating many of the procedures described in the paragraphs on spinal curvatures.

The 45° anteroposterior film is made by tilting the tube 30–45° toward the patient's head, and directing the central ray either through, or just above, the symphysis pubis, having the film so placed that the central ray falls at its center. This view is of great value in demonstrating congenital deformities, and also injuries and disease conditions.

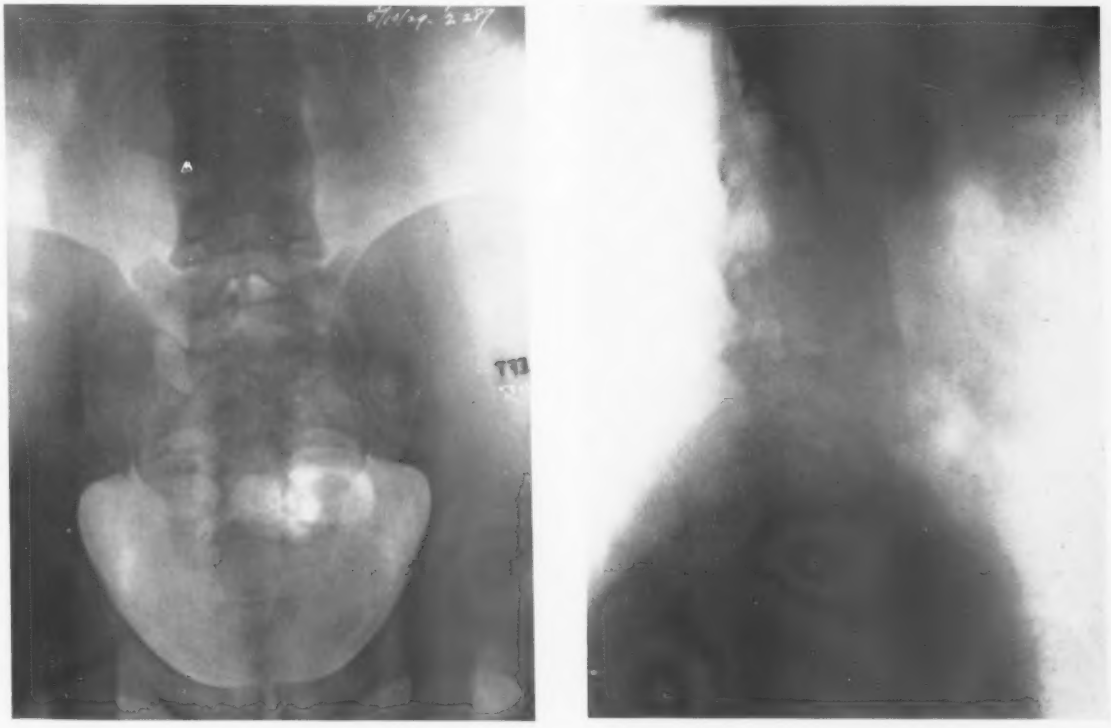
Other valuable projections of the lumbosacral region for demonstrating deformities and pathology, especially of the small articular processes, are shown in Figures 10 and 11, the right and left oblique views, as described by Ghormley and Kirklin.[4]

Figures 12 and 13 illustrate a congenital defect which has greatly interested orthopedists, the congenital bilateral separation of the neural arch of the fifth lumbar vertebra between its superior and inferior articular processes. This condition is probably the predisposing cause of most, if not all, cases of spondylolisthesis, and is sometimes referred to, before the forward displacement of the lumbar spine on the sacrum has taken place, as prespondylolisthesis, or potential spondylolisthesis. It is to be noted how clearly the defect can be seen in the 45° anteroposterior view, as well as in the lateral. If this defect occurs in the neural arch of the fourth lumbar vertebra, the forward displacement will be of the lumbar spine on the fifth lumbar vertebra;

Fig. 3. Congenital deformity. Hemivertebrae of lumbar spine. The hemivertebrae have spread laterally, showing the deformed neural arches between them.



Figs. 4 and 5. Congenital deformity. Two unsegmented vertebrae.



Figs. 6 and 7. Congenital deformity. Large incompletely segmented portion of lumbar spine.

Fig. 8. Ordinary anteroposterior view of lumbosacral region. Compare with Figure 9, a very useful supplementary view. See text.

and occasionally, the defect has been in the third lumbar vertebra, with forward displacement of the spine on the fourth lumbar vertebra.

The chief clinical importance of these deformities and anatomical variations lies in the following facts: (1) they may cause, or be instrumental in producing, gross deformities, such as curvatures of the spine, or spondylolisthesis; (2) many orthopedic surgeons believe that they constitute structural weaknesses, and produce instability of the spine, especially in the lumbosacral region, and may predispose to severe and protracted symptoms from comparatively trivial strains and injuries; (3) they may easily be mistaken for the result of injury, which is particularly important from the medicolegal standpoint.

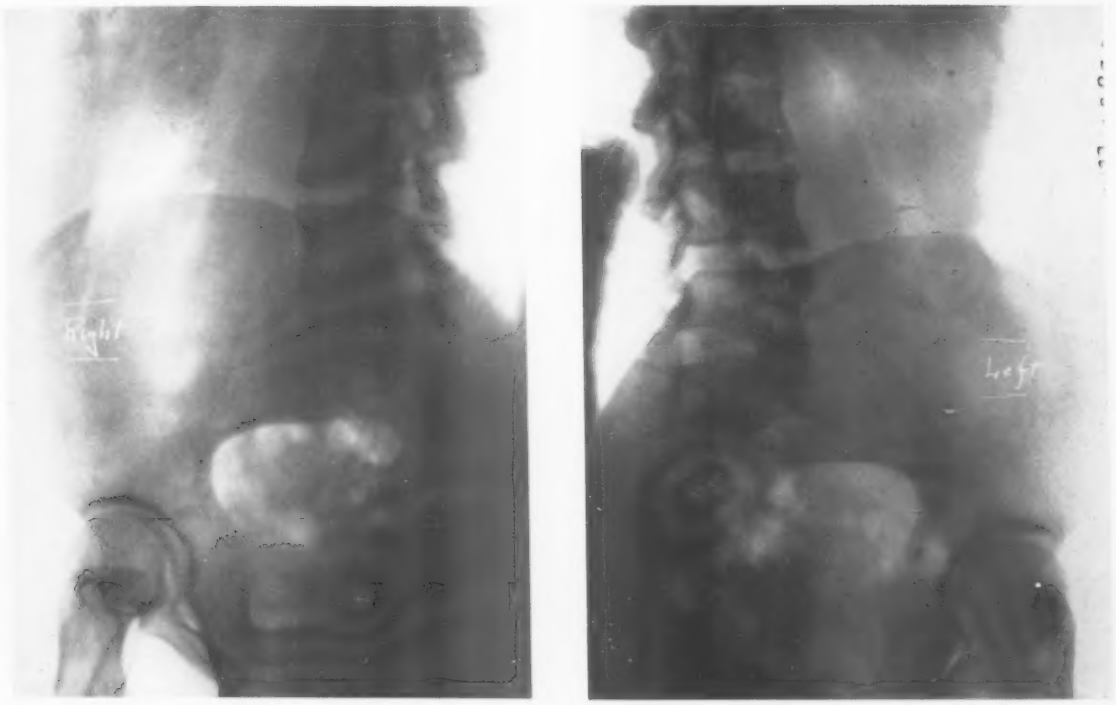
The second subject on which I wish to touch is spinal curvatures, particularly scolioses. The more common causes of these are: (1) congenital deformities, especially hemivertebrae; (2) paralyses; (3) vertebral epiphysitis or osteochondritis; (4) the so-called idiopathic scolioses, which simply means that the cause is undiscovered.

The association of congenital deformities and scoliosis has been mentioned above (Fig. 14).

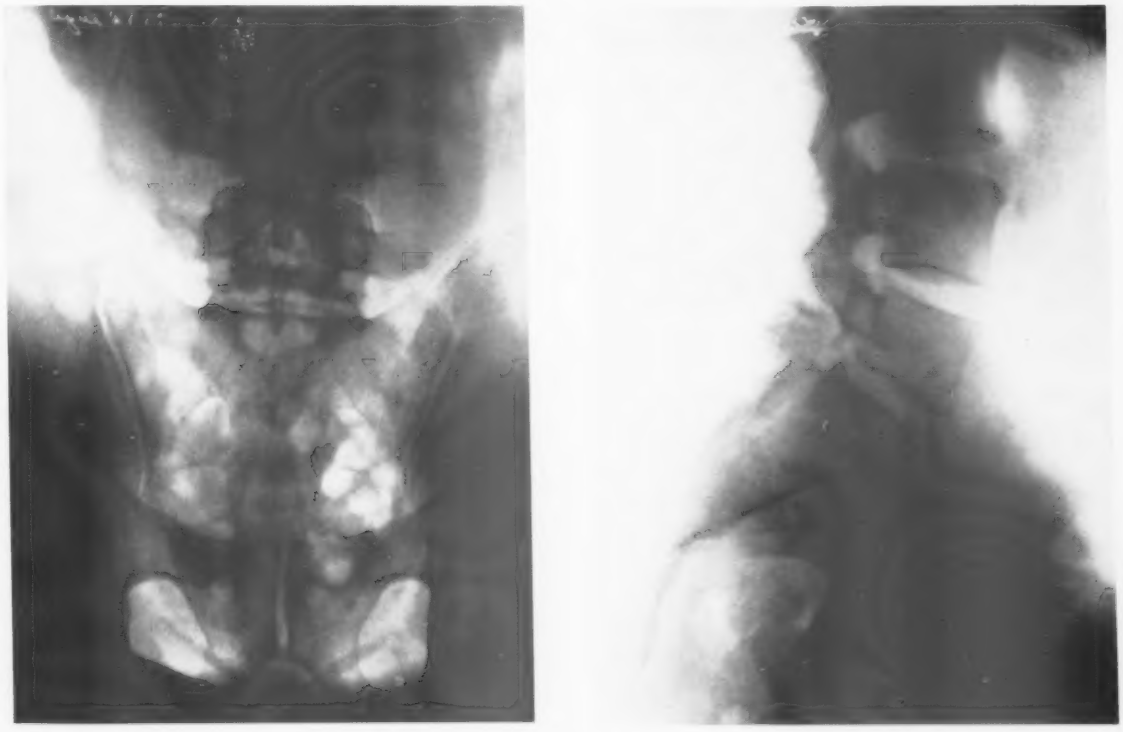
Any spinal muscle imbalance from paralysis or other cause is of course bound to produce a rounded deformity with the convexity toward the weakened side. Some orthopedists believe that many scolioses are due to mild and unrecognized attacks of infantile paralysis.

The relationship of vertebral epiphysitis or osteochondritis to curvature is an interesting one. The two are frequently found associated, and many clinicians believe that the former produces the latter. Epiphysitis of the bodies of the spine occurs usually during the period of rapid growth, roughly from about ten to fourteen years.

Fig. 9. So-called 45° anteroposterior view. Compare with Figure 8. Shows particularly well the sacroiliac joints, lumbosacral joint surfaces and disc, the articular processes and facets, and the fifth lumbar neural arch.



Figs. 10 and 11. Right and left oblique views, particularly for study of the small articular processes of the lumbosacral joint.



Figs. 12 and 13. Congenital deformity. Bilateral failure of fusion of the neural arch of the fifth lumbar vertebra between its superior and inferior articular processes. Condition sometimes called prespondylolisthesis or potential spondylolisthesis.

Its exact etiology is not known, but it is believed to be similar to the osteochondritis in other regions, such as Legg-Calvé-Perthes' disease, Osgood-Schlatter's disease, and Köhler's disease. Its roentgen appearance is characterized by irregularities in ossification of the epiphyses of the vertebral bodies, irregularities in the outlines of the epiphyseal cartilages, and irregularities in the surfaces of the bodies

Fig. 14. Scoliosis produced by hemivertebra.

beneath the epiphyseal cartilages, especially notching. Because the changes are not limited to the epiphyses, and the deformities are often greatest in the bodies, osteochondritis seems a more descriptive and accurate term for the condition.

Just as in Perthes' disease, the disease with weight-bearing and muscle tension produces deformity of the hip, so it seems reasonable to believe that vertebral osteochondritis may be followed by scolioses and hollow round back deformity (Figs. 15 and 16).

What information would the orthopedic surgeon like the roentgenologist to provide in these spinal curvature cases? First, the clinician wishes to know the etiology. Therefore, the roentgenologist tries to establish the presence or absence of congenital deformities or osteochondritis, as discussed above. Next, he can test for muscle imbalance, though he must remember that the finding of such does not prove conclusively that the scoliosis was caused by a paralysis. For the imbalance might follow the gradual muscle stretching and weakening of a scoliosis of considerable duration, rather than being the cause of it.

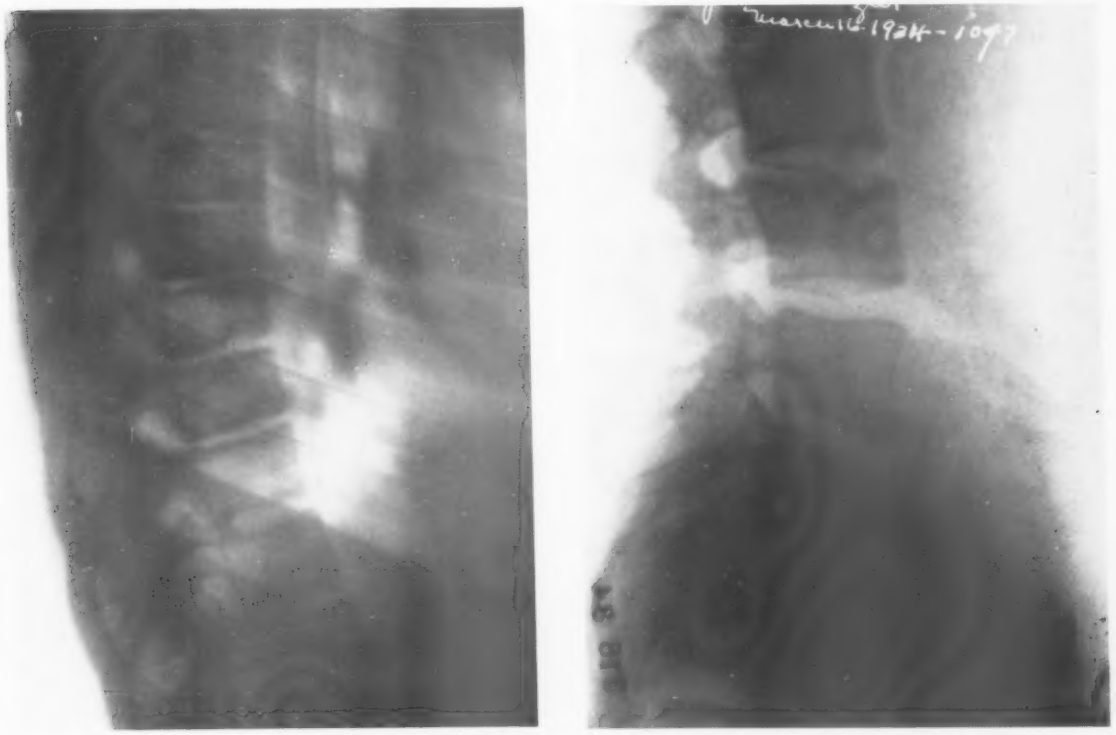
The method of testing for muscle imbalance is as follows: a film of the spine is made with the patient sitting. The hip on the convex side of the curve is then raised about 3 inches by placing a book or some other object under it, and another film is made. These two films are then studied. If in the second film, with the hip elevated, the curve tends to straighten itself out, and the spine pull itself into the vertical, this is evidence that the muscles of the suspected side are functioning well, and that the deformity is probably not the result of paralysis (Figs. 17 and 18). If comparison of the two films does not show this change, we have evidence of muscle imbalance.

The second bit of information sought from us concerns the prognosis. Is the curvature likely to increase, and how correctable is the deformity? If the patient is in the age of most rapid growth, roughly from about ten to fourteen, the deformity will in all probability increase. If there is muscle imbalance, which we have determined by the previous procedure, the likelihood of increase is greater than if it does not exist. Also the difficulties of correction are greater. If the spine is quite flexible, the curvature is more apt to increase than in a somewhat fixed and rigid spine. Also it is more subject to correction of the deformity. We can test for flexibility thus: the patient is roentgenographed in the supine and sitting positions, and the degree of curvature compared. If the deformity is considerably

greater in the sitting position, the spine is obviously quite flexible (Figs. 19 and 20).

If there have been previous roentgen studies, comparison of the present with the previous films will give much information as to the progress of the case. If, however, the growth of the child has been rapid, which is often the situation in these scolioses, comparison of tracings, or superimposition of films, often leaves one in considerable doubt as to the smaller changes which may have taken place in these deformities. For the sake of greater accuracy, Dr. Ferguson, of the New York Orthopedic Hospital, has devised a very useful and practical method for recording the progress of these cases. It is believed that by this method measurements within 5 degrees of accuracy can be made of the deformities shown in films taken at different times, but under similar conditions. That is, the films compared must all be taken in the supine position, or all sitting, and without jackets or braces. If these appliances are used, there must be a greater allowance for error.

The method is as follows (see Figs. 19 and 20): a dot is placed in the center of the body of the vertebra at the top of the curve, this vertebra being the one showing no rotation or the least rotation. A second dot is placed in the center of the body at the apex of the curve, this vertebra being the one showing maximum rotation. A third dot is placed in the center of the body at the bottom of the curve, this vertebra being the one showing no rotation, or a minimum of rotation. The first two dots are now connected by a straight line, and this line is continued downward. The second and third dots are connected by a straight line. The angle formed by these two lines is measured and recorded as the angle of deformity.



Figs. 15 and 16. Moderate dorsum rotundum deformity in well-developed case of vertebral osteochondritis.

If a spinal fusion is performed, the patient will be referred at intervals for check up as to progress. Much information can be given by these examinations: the extent of the fusion; the amount, density,

Fig. 17. Right rotary lateral curvature, with apex at about the twelfth dorsal vertebra. Film taken in sitting position.

and continuity of the new bone; if a graft has been used, whether it is firmly fixed, and appears vital and intact. Comparison of the present degree of deformity with the previous is very important. There should be no cause for surprise if the deformity is less than before the operation, for much preoperative correction is frequently obtained by the use of frames, traction, or hinged jackets. If, however, the deformity is greater than before operation, things are not going as they should, and we must search for the cause. We may visualize a point in the fusion which appears weak. We can check on this by taking supine films with maximum right and left bending, and, by measurements, determine whether there is motion in the fused area of the spine (Figs. 21 and 22). And sometimes, by study of these films, we can detect the exact spot where the motion takes place.

And, in passing, I would like to call attention to the fact that the degree of solidity of fusions of the lumbosacral joint, or of fusions for fractured vertebral body, can be tested by taking lateral films in maximum flexion and extension, and comparing the angles of the fused area in the two positions. The centers of the bodies may be used as points of measurement, or the anterior surfaces of the bodies (Figs. 23, 24, 25 and 26).

In scoliotic cases where the deformity is obviously increasing though the fused areas are solid, it should be noted whether this increase is taking place above or below the fusion. The operation may not have been sufficiently extensive.

The third subject which I wish to discuss is injuries of the spine. The one or two points I wish to mention are not new, but will probably bear this brief repetition. In

Fig. 18. Same patient as Figure 17, taken with right hip elevated. Note that spine in region of curve apex has become straight, indicating good musculature on the convex side of the curve.

certain compression fractures of the bodies, in which no breaks in the cortex can be distinguished, and where little if any disturbance of the structure of the body can be visualized, I believe it is impossible to state with any certainty whether the fracture is old or recent.

Then there are doubtless some fractures of the bodies which will escape detection even with the most painstaking study of films of the finest quality. Baensch's[1] very illuminating demonstration of the amount of destruction of cancellous portions of a vertebral body which can escape roentgen detection as long as the cortex remains intact, lends strong support to this view. In the opinion of many observers, the late deformity of undetected fractures is what constitutes Kümmell's disease.

In a fresh fracture, hyperextension treatment, in addition to reducing the kyphosis, will sometimes correct considerably the deformity of fractured bodies, as described by Davis[2] (Figs. 27 and 28).

There is much discussion at the present time about the nucleus pulposus of the intervertebral disc and its pathology, especially rupture and herniation into the vertebral bodies. I have no doubt such conditions exist (Figs. 29 and 30).

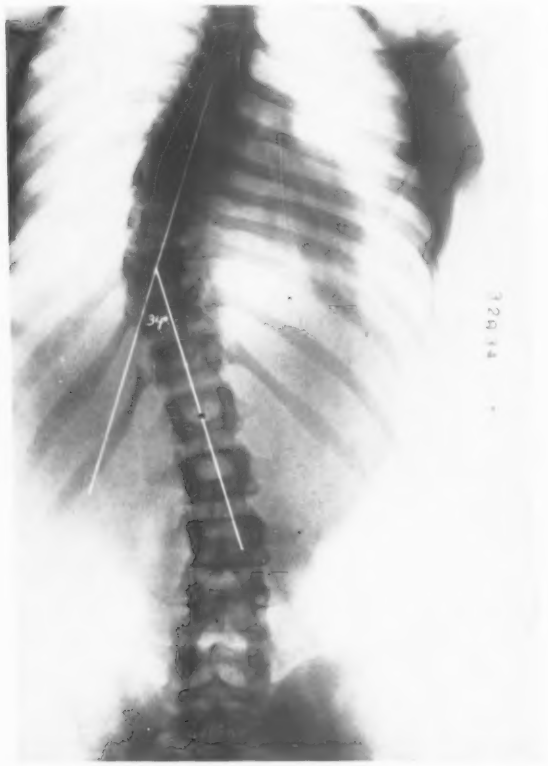


Fig. 19

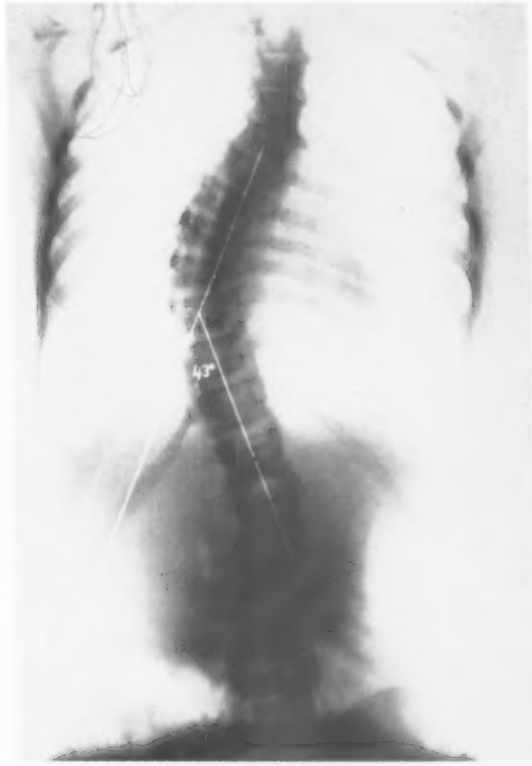


Fig. 20

Figs. 19 and 20. Demonstrating convenient method of recording degrees of deformity in scoliosis. See text. Also demonstrating flexibility in a spine with curvature. Figure 19 made in supine position, Figure 20 with patient sitting. Note deformity is considerably greater in sitting position.

But I think the enthusiasm over a new idea, or newly emphasized idea, leads to the discovery of more of these lesions than actually exist. When I discussed earlier the condition of vertebral osteochondritis, I called particular attention to the irregularity of ossification of the epiphyses and to the notching of the bodies under the epiphyseal cartilages. I believe that many of these deformities resulting from osteo-

chondritis persist for years, if not permanently, and are characterized by the roughening of the upper and lower surfaces of the vertebral bodies, with notching.

Some of the illustrations appearing in the literature as multiple herniation of nucleus pulposus, in young patients, with dorsum rotundum, with wedging of the vertebral bodies, are identical with what we have been considering for several years as vertebral osteochondritis, or the late deformities resulting therefrom (Fig. 31). And since we see many such cases without history of injury, I believe our diagnosis is the more probable. Incidentally, in passing, I think these deformities from vertebral osteochondritis, especially in patients in the late twenties or early thirties, are quite frequently erroneously diagnosed arthritis.

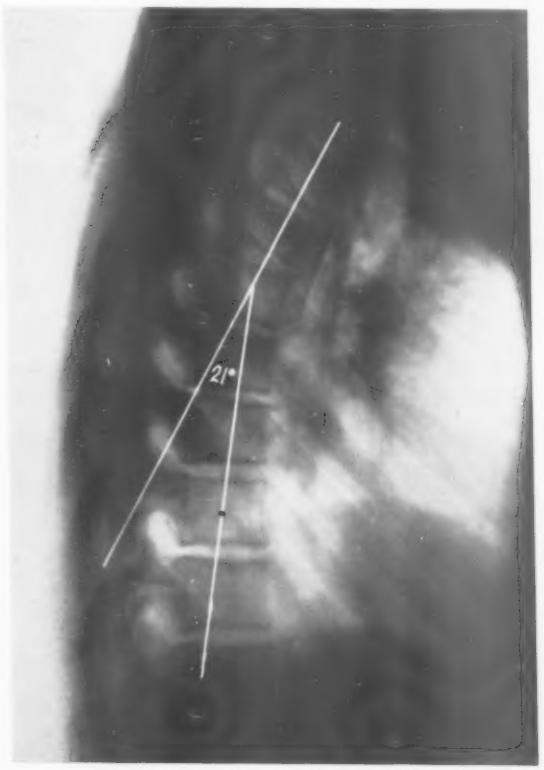
The fourth point is infections. We all have a fair experience with, and knowledge of, tuberculosis of the spine, and I will not discuss that disease here. And we all see many cases of so-called chronic osteoarthritis of the spine. With regard to the latter condition, it is important to evaluate the findings in the light of the patient's age and occupation, remembering that hypertrophic changes in the spine occur naturally in many individuals past forty, and especially if they have done heavy physical labor. And in such persons these changes, if more or less generalized, must not be considered pathological. And for this reason, as urged by George and Leonard[3] and others, it is probably better to designate them as productive or hypertrophic changes, rather than osteoarthritis. If, however, these changes are sharply localized to a very limited area in the spine, one must consider the possibility of injury or infection as a cause.

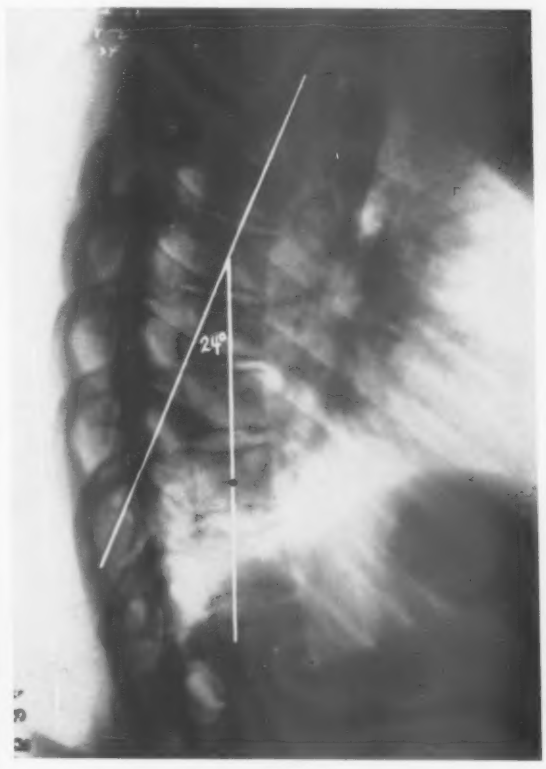
Figs. 21 and 22. Testing for motion in a fused area of the spine by making films in maximum right and left bending, and measuring angles of deformity. Fused area solid in this case, as no motion is demonstrated.

Fig. 23

Fig. 24

Figs. 23 and 24. Demonstrating method of testing motion in lumbosacral joint, by taking films in flexion (Fig. 23) and extension (Fig. 24). Lines drawn parallel to anterior surface of first sacral segment and fifth lumbar body. Particularly useful after lumbosacral fusions.





Figs. 25 and 26. Testing for increasing scoliosis over a period of time, following a fracture of a vertebral body. Centers of bodies used as points of measurement.

Fig. 27

Fig. 28

Figs. 27 and 28. Showing reduction of deformity of fractured vertebral body accomplished by hyperextension treatment. Figure 27 before treatment; Figure 28 after treatment.

Figs. 29 and 30. Old case of rupture of nucleus pulposus.

Infections of the spine other than tuberculosis and osteoarthritis are much less common, are less well known, and, in my experience, are very difficult to diagnose and classify. Infections known to occur in the spine are the following: acute and less acute osteomyelitis from such organisms as the staphylococcus and streptococcus; typhoid arthritis, lues, Neisserian infections, fungus infections, undulant fever. And then, of course, there is the general utility and almost all-inclusive category of infectious arthritis. This term, as I understand it, includes infections from unknown organisms, and also from many specific known organisms. It includes rheumatoid arthritis, toxic arthritis, and such. I believe it is better to use this term only in the light of a provisional diagnosis, though sometimes we have been forced to continue it as a final diagnosis through inability to arrive at a more precise diagnosis.

Fig. 31. Vertebral osteochondritis. Sometimes erroneously diagnosed as multiple herniations of the nucleus pulposus into the vertebral bodies.

With regard to osteomyelitis of the spine, there occurs rather infrequently a relatively mild form, recently described by Smith,[5] which is distinguishable only with great difficulty from tuberculosis. This causes bone and cartilage destruction, and produces paravertebral abscesses. Eleven of Smith's 17 cases had been previously diagnosed tuberculosis by competent orthopedists. Points in differential diagnosis mentioned by him are: (1) average age of these patients older than in tuberculosis, which usually begins in early childhood; (2) these lesions frequently followed or preceded pyogenic lesions in other parts of the body; (3) there is rarely ever as much destruction of the vertebral bodies in osteomyelitis as in Pott's disease; (4) there is evidence of a productive reaction about these lesions with tendency to early ankylosis of the bodies.

As examples of non-tuberculous infections of the spine, we have 4 cases which serve to illustrate the great difficulty in making exact diagnoses in these infections. These cases, previously reported by Dr. Armitage Whitman and myself, have been accepted for publication, and will probably appear in print in the near future.*[6]

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* Published since reading of this paper. See reference for case reports.

LATERAL ROENTGENOGRAPHY OF THE NECK OF THE FEMUR*

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ABOUT two and a half years ago, we became interested in lateral roentgenograms of the neck of the femur. This was done to perfect a means for introducing a double-screw of special design without opening the hip joint where non-union had complicated an intracapsular fracture of the neck of the femur.[1]

Although the work was originally undertaken with this idea in mind, the larger aspects of the problem soon became apparent; in brief, that the accurate reduction of all fractures, including those of the neck of the femur, is dependent on the checking of the position of the fragments by roentgenograms taken in both the anteroposterior and lateral planes. Great technical difficulties were experienced in attempting to achieve standard results. In the main, these are: distortion of the image, haziness of outline, and a tendency to miss the head and neck of the femur wholly or in part. As a result of this study, the reasons for these difficulties are better understood, some are entirely overcome, others in part only.

All methods devised for taking roentgenograms of the neck of the femur fall into one of two distinctly different classes. They differ in that in one the film is placed on the outer side of the thigh and in the other, the film is placed on the inner. In

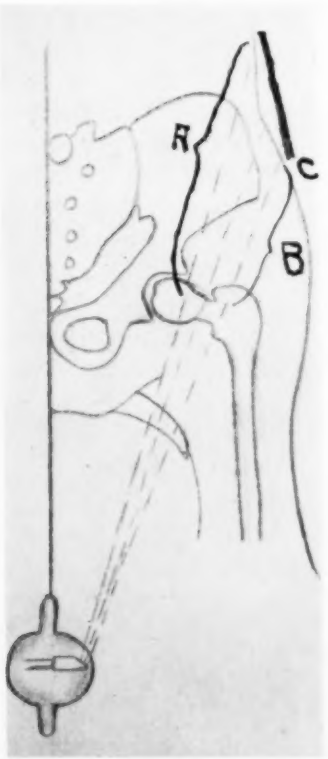

FIG. 1. Diagram illustrating first method. Note difference in length of lines *A* and *B*. *A*—Distance from head of femur to cassette. *B*—Distance from trochanter to cassette. *C*—Cassette.

FIG. 2. Lateral roentgenogram of head and neck of femur taken by first method (from Johnson). Note distortion of relative size of head to trochanter as compared with actual photograph (Fig. 3).

* From the Surgical Service of the Menorah Hospital, Kansas City, Mo.

other words, in the first method the rays pass from within outward and in the other from without inward. An example of the first general class, with a slight modification, is illustrated by a recent article by Johnson,[2] viz., taking the picture from within outward (Figs. 1 and 2). In an attempt to simplify the technique so that the neck of the femur would not be missed, he contrived an "anglometer" which enabled him to determine the angle made by the neck of the femur with the shaft. In reality, a slightly oblique view rather than a true lateral is taken. Objections to this method are: distortion of extremely high degree, overshadowing the outer portion of the neck by the projected image of the trochanter, and the impossibility of doing this at all when the patient is on the metal pelvic support of the fracture table. As a result, the upper surface of the head and neck of the femur is projected on the sensitized film. An actual photograph of this surface was made (Fig. 3). The resultant distortion can be estimated by comparing

FIG. 3. Photograph of superior plane of head, neck and trochanter.

FIG. 4. Diagram illustrating second method (from Leonard and George).

the photograph and the roentgenogram, particularly in the relationship of the size of the head to the trochanter in each. Particular attention is called to the great difference in length of lines *A* and *B* in Figure 1 which will be discussed later as the major cause of this phenomenon.

The second general class is illustrated by a recent article by Leonard and George.[3] Here, a semicircular curved cassette has been introduced to modify the usual procedure. Figure 4 is an almost exact copy of the one used in their article, and illustrates their technique far better than a description. A roentgenogram made by this method is also reproduced (Fig. 5).

Reference has already been made to the disturbing variation in results. While engaged in taking lateral roentgenograms of the hip joint, using a somewhat similar position to that indicated by the second

Fig. 5. Lateral roentgenogram of the neck of the femur showing projection of head to extreme edge of film (from Leonard and George).

method, we soon noted that the closer the tube was placed to the body of the patient, the less likelihood there was of missing the head of the femur entirely. As we were not using a shock-proof unit, there came a point where we could not approach closer without endangering the patient. It was then that the solution of twisting the patient's torso out of the way by rotating and side bending of the spine was used for the first time, and this one simple maneuver entirely solved the troublesome problem of position.

DESCRIPTION OF TECHNIQUE

The Position. The patient, as in Figure 6, is placed on the fracture table in the Whitman position, that is, with both legs widely abducted and internally rotated. It should be noted that internal rotation must be extreme—to the limit—to place the head and neck in the horizontal plane. The cassette is placed as indicated. The tube, 36 inches from the cassette, is placed at the shoulder on the same side as the femur about to be filmed. Just before the roentgenogram is taken, the arm on this side is grasped and the upper portion of the body rotated away from the tube. The rays travel almost through the vertical plane of the body.

The use of a 3 inch cone has been found to improve contrast. The exposure factors used, which will of course vary slightly for the usual technical reasons, are as follows: at 36 to 40 inch distance, we have been using about 20 ma., 70 kv., for 15 seconds.

The Cassette. (Fig. 7.) The first model was described in the article previously referred to[1] and had been in use for twelve months before that date. Therefore, its design was not influenced in any way by the semicircular cassette of Leonard and George which was designed for a general rather than a specific use. My attention has been called to a curved cassette of a somewhat different type designed in 1924 by Dr. Van Allen of Springfield, Massachusetts. As the description was not published, it was not recognized in the original description.

The cassette about to be described is the fourth model. Many modifications have been made as actual experience demonstrated faults in the preceding ones. When viewed from the side, it has a hockey-stick curve. The shorter upper portion makes an angle of 135° with the lower, corresponding to the usual angle made by the neck of the

Fig. 6. Drawing illustrating position of patient for lateral roentgenography of the head and neck of the femur. Note that the trunk is removed from the path of the rays by rotation and side bending of the spine.

femur with the shaft. It takes a $6\frac{1}{2}'' \times 8\frac{1}{2}''$ film, a standard size but one not commonly used. The reason this size was reluctantly adopted is that, with the patient on the fracture table with traction applied to both legs, the pubis is in close proximity to the metal pelvic post. The cassette must be slipped between the patient and the post, and it must be neither too large for easy application nor too small for the object. The following materials compose the face of the cassette. They are, in order, bakelite, pure lead foil of 0.004 inch thickness, on which is laid four thicknesses of white crepe silk. The front screen is then fixed to this combination.

Before discussing troublesome technical factors, an experiment was performed which will be referred to so frequently that it is necessary to introduce it at this point in the interest of clarity.

A subject was placed in the position previously described, for the taking of the lateral roentgenograms of the hip. Two copper rods, paralleling the sides of the 3 inch cone used, were placed beneath the patient. Two iron plates, the exact size of curved and straight cassettes, were placed between the legs of the patient. An anteroposterior exposure was then made at 7 foot distance. From this teleroentgenogram, exact measurements could be made on the film with negligible correction for roentgen distortion. Figure 8 represents a tracing made from this film, which is in effect, an anteroposterior roentgenogram of the various factors involved in lateral roentgenography.

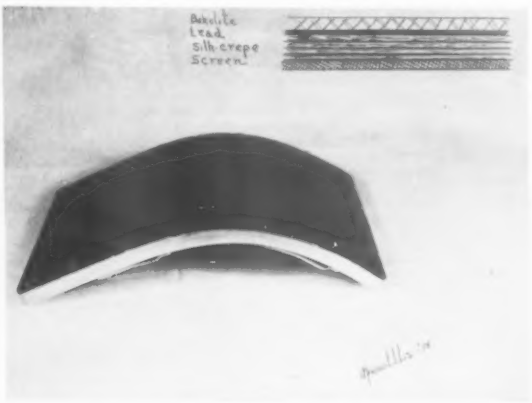

Fig. 7. Drawing illustrating the position of copper screen in the face of the cassette.

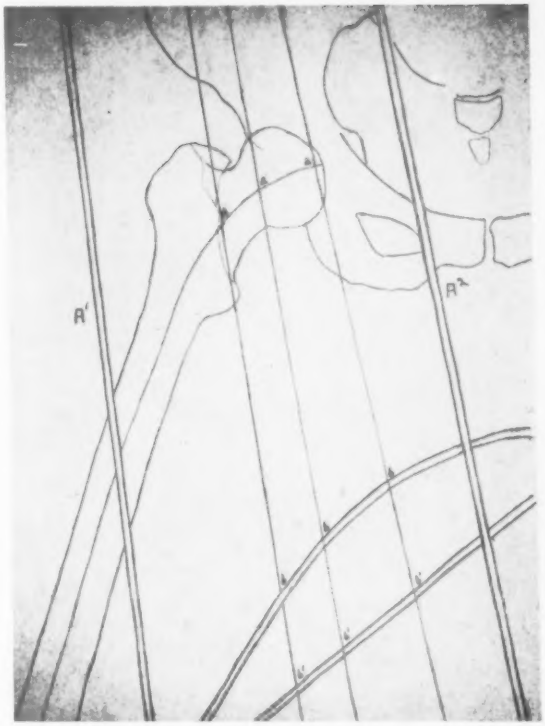

Fig. 8. Tracing made from anteroposterior teleroentgenogram while the patient was in position for a lateral roentgenogram. *a*—Central line of femur. *b*—Metal bar in position of curved cassette. *b'*—Metal bar in position of straight cassette. *A'* and *A²*—Copper bars paralleling sides of cone indicating path of roentgen beam. Note: The three lines, *a–b*, are approximately equal in length. Compare with Figure 1, lines *A* and *B*.

We have already stated that the difficulties encountered in taking lateral roentgenograms of the head and neck of the femur are: distortion of the image, haziness of outline, and a difficulty in accurately localizing the head and neck on the negative.

Distortion may be defined as the tendency for a reproduced image to vary widely from the known shape of the object. This is due to a difference in distance of the various parts of the object from the sensitized film. Photographically, this is illustrated by the well-known example of

Fig. 9. Lateral roentgenogram of the head and neck of the femur made by the described technique, illustrating the lack of distortion in relative sizes of head and trochanter, and central position of image on film.

the hands being closer to the film than the remainder of the body, thus acquiring a disproportionate enlargement. Roentgenographically, this is well illustrated by the first method discussed. Here distortion is extreme, and a study of Figure 1 shows that the great disproportion between lines *A* and *B*, previously referred to, adequately explains this result. In Figure 8 it will be noted that the three lines passing through the head, neck, and trochanter to the curved cassette (each labelled *a–b*) are of approximately the same length.

The same test for distortion should be applied to both methods and the results compared. Using this technique, the lower surface of the head and neck of the femur are projected on the sensitized film (Fig. 9). A comparison of the actual photograph with the roentgenogram shows that there is little distortion as regards the relative size of the head and the trochanter. The photograph (Fig. 10) demonstrates clearly the degree of angulation at the head and inner half of the neck on the outer half. This relationship is definitely preserved in the roentgenogram and has proved itself of practical value.

The second technical difficulty, haziness of outline, is due to two causes: secondary radiation and great object-film distance. It is felt that the former is the more important of the two.

Secondary radiation, or deflection of the rays from their original path, occurs where a roentgenogram is taken through a great thickness of tissue. The distance traversed by the ray in taking these lateral views

Fig. 10. Photograph of inferior plane of head, neck and trochanter.

equals that encountered in making lateral roentgenograms of the spine. In the thin subject used for Figure 8 the actual measurements were: lateral spine distance 11 inches, lateral hip joint distance 11½ inches.

We are all familiar with the vast improvement that has taken place in the detail of spinal roentgenograms since the universal adoption of the Potter-Bucky diaphragm. Obviously, this device cannot be used to screen out secondary rays, because of its size and shape. Many materials have been incorporated in the face of the cassette to decrease this cause of fogging. The original suggestion of Dr. David S. Dann was that a copper screen be used. This was found to improve results. It was our opinion that this screen acted as a filter for the less penetrating secondary rays rather than as a true grid. Later developments have proved this. Mr. E. B. Coufal then suggested that lead foil replace the copper screen. Lacking apparatus for physical measurement and solely through the laborious photographic method of trial and error many combinations of various materials were tried. The most satisfactory combination to date is that being used at present, namely, lead foil having a thickness of 0.004 inch backed by four thicknesses of crepe silk. We believe that this work is of sufficient interest to be made the subject of a later report. It will suffice at this time to state that secondary radiation has been decreased, effecting greater detail in the film.

The second cause for lack of detail is not so easily overcome. Again referring to Figure 8, by actual measurement on the film it was noted that the neck of the femur was 6½ inches from the sensitized film encased in the curved cassette. Figure 11 is introduced to explain why this great distance of the object from the film will in itself cause lack of detail. Roentgenograms were made of a small piece of screen wire at varying distances from the film, the target-film distance remaining the same. The resulting photographs were then studied for detail. It will be seen that there

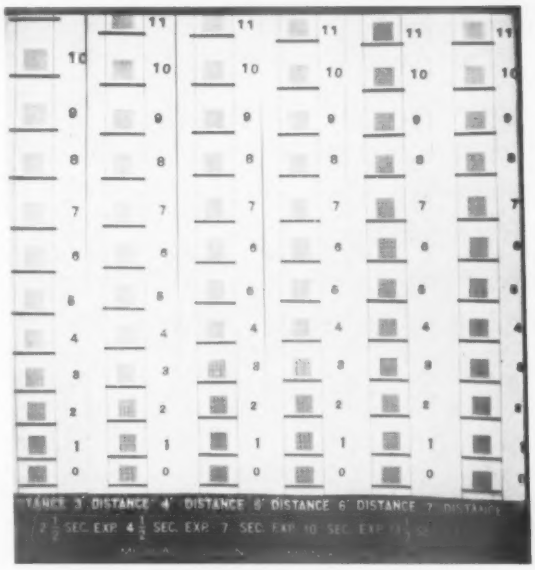

Fig. 11. Experiment made to determine the causes of haziness in films. Roentgenograms of a small square of screen wire with this object at varying distances from both sensitized film and target of tube. Haziness occurs when distance (in feet) of the object from the tube-target is less than ten times the distance (in inches) of the object from the film (Eastman Kodak Company).

are vertical numbers running from 0 to 11. This represents the distance in inches of the wire from the film. The upper set of horizontal figures, labeled "Distance 3', Distance 4'," etc., represents the distance in feet of the target of the tube from the film. The figures below this, reading "Exp. 2½ sec." etc., indicate the duration of time the film was exposed. Inspection of this chart will show that photographic detail becomes blurred unless the target-film distance in feet is ten times the object-film distance in inches.

A simple example would be as follows: A roentgenogram of the hand is taken with the tube placed 30 inches distant from the film; if the hand is moved more than 3 inches away from the film, there is loss of detail and haziness of outline that increases with the distance. Applying this formula to our problem, it would mean that if the neck of the femur is 6½ inches from the film, then to obtain better detail, the tube must be placed about 6½ feet from the film. This

is technically impractical as it would entail the use of penetrations and time factors beyond the capacity of the ordinary unit. Detail has been much improved, but the lateral roentgenogram does not and cannot equal the anteroposterior view in this regard.

The third difficulty, and one that has been entirely overcome, was in accurately localizing the head and neck of the femur squarely in the center of the film. We have previously mentioned that in the first method discussed, where the roentgenogram is taken from within outward, the head and neck are frequently missed entirely as shown by the introduction of special devices to localize it accurately. In the second method, where the tube is placed at the side of the patient, one of two things happens: either the head is missed entirely or is projected to the extreme edge of the film (Fig. 4). A study of Figure 8 will explain why the vertical plane has eliminated this annoying factor.

No attempt will be made at this time other than to indicate wherein we believe this procedure has clinical value. This work has been largely done in relation to intracapsular fracture of the neck of the femur. Although the final conclusions will await a more detailed study of a large number of cases, we join with others in the opinion that the most important cause of non-union is malposition in the lateral plane, in the presence of what seems to be good position in the anteroposterior view. In other words, poor reduction will be followed by non-union.[4] There is good reason to believe that this procedure will find a field of usefulness in the study of congenital dislocation of the hip and other affections in which anatomical relationships in this region are disturbed.

CONCLUSIONS

A technique has been devised by which lateral roentgenograms of the neck of the femur can be taken without appreciable variation in results because: (1) Distortion has been practically eliminated by a curved cassette of special design; (2) haziness of the object outline has been found to be due to two factors, secondary radiation and high object-film distance; (3) the tendency either to miss the head entirely or to project it to the extreme edge of the film has been obviated by a different position.

I wish to express grateful appreciation to Dr. David S. Dann, Mr. Robert Fron and Mr. E. B. Coufal, for invaluable assistance rendered in the completion of this work: to Dr. Dann not only for many original ideas but his sustained interest and advice in every phase of the problem; to Mr. Fron for his ingenuity in devising the technical factors that comprised the several models of cassettes that have been used during this investigation; to Mr. Coufal for his suggestions and photographic experiments which resulted in the improved filter described in the article.

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A TECHNIQUE FOR THE ROENTGEN EXAMINATION OF THE LUMBOSACRAL ARTICULATION

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THERE is probably no other pathological condition which is as common and yet the cause of as much controversy from a diagnostic standpoint as pain in the lower part of the back. It not only presents a problem in the general practice of medicine, but also in the practice of industrial medicine in which a certain percentage of the work becomes medicolegal.

We have concentrated our attention on the lumbosacral articulation for the past three years, during which time a detailed study has been made of approximately 1,000 cases. The symptom usually complained of was pain in the lower part of the back which, in many cases, radiated down one or both lower extremities. It has been considered as being due to muscle strain, sacroiliac disorders, intrapelvic pathological conditions, foci of infection, etc. In approximately 85 per cent of these cases we have been able to demonstrate roentgenographically a lesion of the lumbosacral articulation.

We are convinced that the reason most of these lesions are overlooked is due to the fact that the roentgen technique employed fails to afford a satisfactory study of the region involved. It is our purpose, therefore, in this article to present a technique which we have used for the past two years and which has enabled us to make a diagnosis in these cases.

The lesion referred to is a constriction of the foramina formed by the articulation of the facets of the fifth lumbar and first sacral vertebrae through which pass the fifth lumbar nerves. In the vast majority of cases the constriction is due to a settling of the body of the fifth lumbar vertebra onto that of the first sacral, the settling being due to traumatic or degenerative changes involving the annulus fibrosus and nucleus pulposus of the intervertebral disc.[1,2]

We have attempted various techniques in our study of the low back, among which might be mentioned a lateral view centered over the lumbosacral articulation with the patient standing. The purpose of this procedure was to obtain a true projection of this site in the weight-bearing attitude. This technique was discontinued as a routine procedure due to the difficulty in preventing motion on the part of the patient for a period of time sufficiently long to obtain a satisfactory exposure. Another technique, which we employed for some time but are now using only in special cases, was the inclusion of oblique views of the lumbosacral region similar to those recently described by Ghormley and Kirklin.[3] The object of this procedure was to pose the patient in a position in which the central ray would pass between and be parallel to the surfaces of the lumbosacral facets. However, due to the wide variation of the plane of the articular surfaces of the facets at this site, this technique too frequently did not afford as satisfactory a study as could be obtained by other methods. Another objection was that it rarely showed more than an arthritic involvement of the facets. The primary pathological changes as a rule were not visible.

We do not believe an arthritis of the facets is a primary cause of symptoms, but rather that it is a secondary lesion resulting from a mechanically altered lumbosacral articulation and is definitely a reaction to abnormal stress and strain.

We are inclined in the routine roentgen examination of the lumbosacral spine to place more importance on the anteroposterior and lateral views taken at such an angle as to avoid superimposition as much as possible. The technique which we have adopted necessitates a lateral and a stereoscopic anteroposterior projection. The lat-

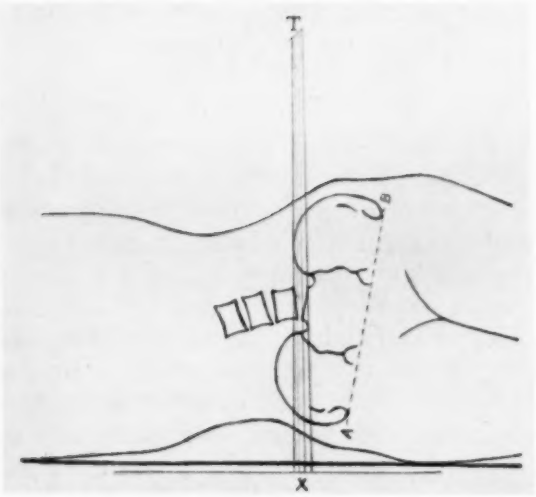


Fig. 1. Usual position assumed by patient in posing for lateral roentgenogram of lumbosacral spine. X represents multiplicity of marginal projections of lumbosacral articulation on roentgen film.

eral film is taken and developed before the anteroposterior study is made. In order to get a true determination of the lumbosacral space, in taking the lateral film, it is essential that the central ray be directed parallel to the superior surface of the sacral table at such a level as to pass through the lumbosacral articulation. The slightest obliquity may so distort the study that positive conclusions cannot be drawn. Therefore, in posing the patient for the lateral film the following factors are important:

1. Superimposition of anterior superior iliac spines.
2. Elevation of the dorsal spine in many cases.
3. Correct projection of the central ray.
4. Extension of the hips.

A careful superimposition of the anterior superior iliac spines assures us that the superior surface of the first sacral segment is perpendicular to the film since the sacrum is attached to and moves with the ilia. This precludes a record of obliquity. It is frequently necessary to elevate the patient's legs by the use of a pillow in order to superimpose these two points.

Due to the fact that the hips are wider than the trunk, particularly in women, it is necessary in many cases to elevate the dorsal spine to a height at which the lumbar spine is parallel to the film thus eliminating the tendency for it to sag. This is best accomplished by placing some form of padding between the patient's chest and the table. When the lumbar spine is parallel to the film the inferior articular surface of the fifth lumbar vertebral body is vertical. When the anterior superior spines are superimposed and the thoracic spine elevated by padding, the opposing articulating surfaces of the fifth lumbar and first sacral vertebral bodies are parallel to each other and vertical to the film (Figs. 1 and 2).

In addition to the foregoing factors, we find that it is also necessary to have the hips and knees in extension when posing the patient. This is due to the fact that in young individuals a reduced lumbosacral joint space, which shows a narrowing posteriorly when in extension, may be restored to almost a normal width, if the hips are drawn in to acute flexion. This denotes an excursion of the facets with a resultant opening and closing of the lumbosacral foramina in flexion and extension. Since the erect posture is one of extension, the

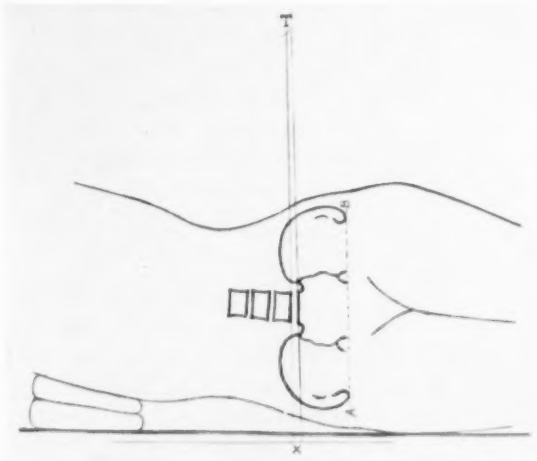


Fig. 2. Correctly posed patient for a lateral lumbosacral roentgen study. A–B, superimposed anterior superior iliac spines; X, projection of lumbosacral space on roentgen film.

extended position in filming is preferable in that it gives a truer representation of the actual condition of the joint while weight bearing.

Having arranged the patient as described, it is now necessary to bring the tube to such a position that the central ray will pass vertically between the fifth lumbar and first sacral segments. We have found this point to be approximately 2 inches below the iliac crest and 4 inches behind the anterior superior iliac spine.

As has been stated the lateral film is developed before the stereoscopic anteroposterior study is made. This procedure has been instituted because of the fact that the anteroposterior tilt of the sacral table varies considerably in different individuals and, desiring the most satisfactory study possible, it is very essential that the central ray pass directly through the lumbosacral joint space and parallel to the sacral table. The tilt of the sacral table in each case can be determined only from the lateral film. The slight distortion resulting from magnification may be disregarded. By means of a ruler the plane of the sacral table is projected forward and backward until it intersects the soft tissue surfaces. These points

Fig. 3. Pointer denotes angle at which central ray must be projected for anteroposterior study as determined from lateral roentgenogram in this particular case.

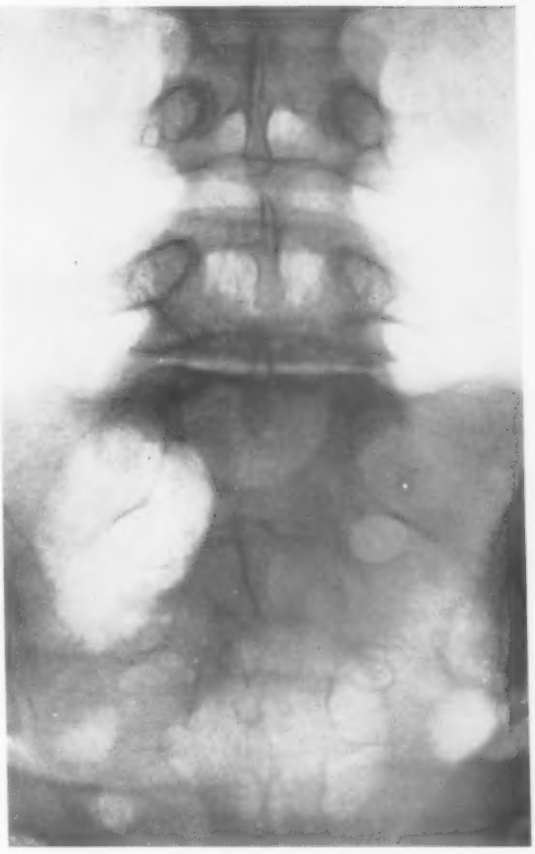


Fig. 4. Anteroposterior roentgenogram of patient suffering from fifth lumbar nerve neuritis (so-called sciatica). Note loss of lumbosacral intervertebral disc, sclerosis and lipping.

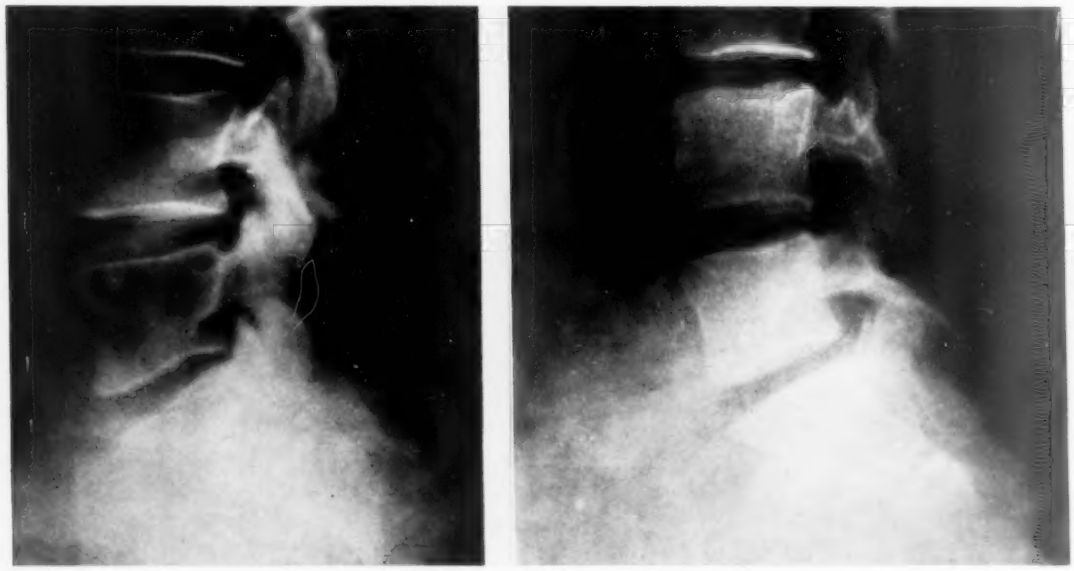
of intersection are measured in their relationship to nearby palpable bony structures. With this information the two points are determined on the patient and the central ray of the anteroposterior stereoscopic projection coincides with a line connecting them (Fig. 3). The hips remain in the extended position unless the angle of projection is greater than 35°. In such a case in order to avoid a distorted roentgen image it is best to reduce the angle by flexing the hips. This does not disturb the relationship of the sacral table to other pelvic bony structures. The tube shift is made laterally rather than vertically so that the central ray will pass through the lumbosacral articulation in both positions (Figs. 4, 5 and 6).

Fig 5. Anteroposterior roentgenogram of normal lumbosacral articulation.

The exposure factors that we usually use for an average sized patient of approximately 150 pounds in weight are as follows: Lateral view, 72 kv. p.; 30 ma.; time, 16 seconds; distance, 36 inches. Anteroposterior view, 67 kv. p.; 10 ma.; time, 6 seconds; distance, 36 inches. The kilovoltage is varied according to the thickness of the patient. A 14″×17″ film is used for the lateral exposure and 10″×12″ films for the stereoscopic anteroposterior exposures.

Our success with the technique herein described has been most gratifying. With its proper use it has been rarely necessary to make additional studies to determine the diagnosis. The importance of careful execution of all factors listed above cannot be overemphasized, as the omission of any of them may result in a distorted view of this region.

It seems somewhat superfluous to state that we who interpret roentgen studies of the lumbosacral articulation should familiarize ourselves with the width of the normal lumbosacral intervertebral disc and



a *b*

Fig. 6. *a*. Lateral study of patient suffering from fifth lumbar nerve neuritis. Note posterior narrowing of intervertebral disc, closure of lumbosacral foramina and subluxation of facets. *b*. Lateral study of normal lumbosacral articulation.

the normal relationship of the articular surfaces of the first sacral facets to those of the fifth lumbar facets. However, due to the recent emphasis which has been placed upon this articulation as a cause of symptoms, we believe such a statement to be justified. In choosing subjects for such a familiarizing study it is important that their histories be free from any symptoms referable to the low back at any time, and that upon examination they do not present an exaggerated lumbar lordosis.

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OXYCEPHALY*

REPORT OF TWO CASES

By ALEXANDER SIMON, M.D., RAOUL RAMOS, M.D., *and* WATSON W. ELDRIDGE, M.D.
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IN 1910 Fletcher[1] reported a series of cases of oxycephaly in the *Quarterly Journal of Medicine*, and brought this condition to the attention of American physicians, although he was not the first to describe this skull deformity. He defined oxycephaly as an acquired disease characterized by a unique deformity of the head, the tower skull, a high degree of exophthalmos, and more or less complete loss of vision. The condition is, however, not necessarily acquired, but may be both congenital and familial, and exophthalmos and loss of vision may or may not be present. In the large majority of cases this classical triad of signs is usually present: (1) tower-shaped skull, (2) exophthalmos, (3) optic atrophy and impaired vision. Mackenzie, in 1854, was the first to attract attention to cranial deformity as a cause of blindness. Most cases, because of visual impairment, came to see ophthalmologists[5] and for this reason the exophthalmos and blindness were greatly stressed in the older literature.

The classical picture is a fairly simple one. The most striking characteristic is the shape of the head. Various names have been coined to describe it—acrocephaly, tower head, steeple head, and, in the German literature, Spitzkopf and Turmschädel. The forehead appears very high and slopes upward to an apex at the bregma. The vertex of the skull is often pointed, and a ridge like the keel of a boat may be felt along the anterior portion of the sagittal suture. The scalp thus looks as if it were perched on top of a cone. The supraciliary and temporal ridges are but feebly marked. The nose may be well formed or deflected to one side. The palate is short and high arched, and the patients are often mouth breathers. The supramaxillary regions may be depressed.

Some degree of exophthalmos is usually present. It may be so marked that the eyeballs can be easily dislocated. A divergent strabismus and nystagmus may be observed. The impairment of vision is dependent upon the degree of optic atrophy that is so frequently associated. The sense of smell is occasionally lost. Hearing and the vestibular apparatus are generally not affected but, rarely, disturbances may be found here also. The intelligence may or may not be impaired. Most institutional cases are of course feebleminded, but this is far from generally true. Fletcher in his series of cases found the intelligence unimpaired. One must consider also that many of these patients suffer from poor sight from early childhood, and this impairs their ability to acquire an education.

There is one group of cases which is definitely congenital, and often familial. Here, there is supposedly a congenital impairment in the growth of the skull bones associated with defective bone formation elsewhere in the skeleton. There may be limitation in joint movements, anomalies of the palate, and a symmetrical webbing of the soft and bony elements of the fingers and toes. This has been called acrocephalosyndactylism. This condition is congenital, although it may manifest itself later in childhood. It is familial and may be transmitted by father and mother to progeny.

Greig[6] has a somewhat different conception of this syndrome. He divides oxycephaly into three groups: (1) True oxycephaly, which is a congenital malformation recognizable at birth and associated with a general synostosis of all the sutures of the skull, producing the typical deformity; and with developmental defects, such as exostoses of the bones of the extremities, and with syndactylism frequently present. Most cases of acrocephalo-

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syndactylism would, therefore, be considered true oxycephaly, if all the sutures of the skull are prematurely ossified. (2) In delayed oxycephaly the premature synostosis, although general, does not occur until early childhood, and it has no related concomitant skeletal defects. (3) In false oxycephaly the synostosis is limited to one or two sutures. This is not congenital and is usually of definite origin. Such a fine distinction is difficult to make clinically, however.

The skull grows rapidly from birth to the seventh year, by which age the foramen magnum and the petrous portions of the temporal bones have reached their full size and the orbital cavities are only a little smaller than those of the adult. Growth is slow from the seventh year to puberty, when a second period of activity occurs. This results in an increase in all directions, but it is especially marked in the frontal and facial regions, where it is associated with the development of the air sinuses. Obliteration of the sutures of the vault of the skull takes place normally as age advances, and this usually occurs after the age of forty, obliteration occurring first in the posterior portion of the sagittal suture, next in the coronal, and then in the lambdoidal suture.

The pathogenesis of this striking disorder is not completely understood. The most generally accepted opinion is that it is due to a premature synostosis of the coronal and sagittal sutures, the bregma being the last portion to ossify. The skull is restricted in growth in the anteroposterior and transverse diameters, and to compensate for a growing brain an increase in height takes place. The middle fossa becomes deepened, the orbits become shallow, and the greater wings of the sphenoid are pushed forward, forming the posterior instead of the lateral walls of the orbit. The cranial sutures play an important rôle in the growth of the skull, but after the growth of the brain is complete, the demand on the adaptability of the skull disappears and synostosis occurs physiologically. If the sutures fuse early, while the brain is still expanding, the skull will become deformed, and in oxycephaly it is the premature closure of the sagittal and coronal sutures which causes the unique deformity. Every case of premature closure of sutures does not necessarily cause oxycephaly.

Bronfenbrenner[3] has been the most enthusiastic exponent of the dynamic formulation in the pathogenesis of oxycephaly. His views follow. In certain groups of feebleminded individuals the brain is retarded in growth at an early age. The ossification of the sutures in these cases occurs as a natural physiologic phenomenon since the skull does not expand if the brain does not increase in volume. But such cases do not show the typical oxycephalic deformity since there is no increase in intracranial pressure to exert its effects. In oxycephaly the sutures begin to close first, and as the brain grows, an increased intracranial pressure results, and in the child with patent fontanelles, the fontanelles are seen to bulge. Premature synostosis of all the skull sutures does not occur simultaneously. Usually the posterior portion of the sagittal suture is the first to fuse. The height of the skull depends upon the membranous areas of separation of the bones being kept open by the expanding brain. As the posterior portion of the sagittal suture is the first to fuse, the anterior portion bulges due to the intracranial hypertension, and as this is last to ossify a projection or keel forms along the sagittal suture in this region.

The continued intracranial hypertension resulting from ossification of the sutures in the presence of an expanding brain results in certain characteristic changes. The orbital cavity becomes very shallow and the exophthalmos results. In some cases a narrowing of the optic foramen has been found at necropsy and this observation has been brought forward as an explanation for the optic atrophy, but since optic atrophy may be found without evident narrowing of the optic canal, it is more

probable that the optic atrophy is secondary to the continued high intracranial pressure. The air sinuses are underdeveloped for the same reason, the intracranial hypertension not allowing the air sinuses to expand normally. Synostosis may occur early in the bones of the hard palate, which, unable to expand laterally, remain narrow while the alveolar processes growing downward, increase the depth.

The effect of this skull deformity upon the brain is variable. A number of these

Fig. 1. Case 1. Note the high head, the high sloping forehead, the feebly marked supraciliary ridges.

cases are feebleminded or epileptic, but this is not the general rule. As soon as synostosis of the skull sutures occurs the brain is not free to expand. Since the increase in intracranial pressure is very gradual the cerebrum can readjust itself to the changing hydrodynamics intracranially. If the skull expands enough the brain is very little, if at all, affected except for the loss of vision which results from the optic atrophy. The amount of cortical damage thus depends on the degree of intracranial pressure, which in turn is dependent on the age and speed at which synostosis of the sutures occurs.

There have been many theories advocated for the cause of the premature synostosis. Virchow believed it to be a sequel of meningitis, calcification following in the wake of the infectious process. Meltzer[7] suggested a rachitic origin, but this is highly improbable, and Bertolotti's[2] theory of a lymphatic dystrophy associated with rickets is also not tenable. Syphilis in the patient or parents is frequently cited, but the association as an etiological factor has never been proved. Fletcher suggested pituitary changes but the changes seen in the sella turcica roentgenographically are more probably the result of continued intracranial hypertension rather than actual pituitary pathology. Some cases, particularly those described as acrocephalo-syndactylism, are undoubtedly hereditary and familial in character, and dependent upon a developmental anomaly.

Roentgenograms of oxycephalic skulls show a fairly typical picture: synostosis of sutures, the characteristic peak of the calvarium at the bregma, thinning of the skull bones, rudimentary small air sinuses, widening and erosion of the sella turcica; and the base of the skull, particularly the middle fossa, appears pushed down.

This condition has little or no effect upon the length of life. There is no medical therapy which can stop the course of the disease. Extensive linear craniectomies[1,8] have been performed with more or less success in preventing exophthalmos and blindness.

CASE REPORTS

Case 1. A. Z., a colored male, aged forty-four, was first admitted to St. Elizabeth's Hospital on September 14, 1916, with the note that the patient was suffering from epilepsy and that he was disoriented and irrational. His father was a chronic alcoholic and one of his brothers died in a hospital for mental diseases. His vision was defective from birth, and he attributed his slow progress in school to this factor. It required five years for him to complete two grades. He had a sore on his penis in 1924, and gonorrhea in 1917. His illness began in 1915 during a period in which he was drinking a great deal. He felt a flash pass over him, and he fell to the ground, remaining unconscious for three hours. These attacks occurred twice a month following this. Until the patient's discharge in March, 1918, he displayed transitory

periods of excitement and emotional instability. Only a few convulsions occurred during his stay. In June, 1926, he was readmitted to the hospital, with the note that he was suffering from epileptic attacks, auditory hallucinations, and delusions of persecution. Mental examination indicated the patient to be an epileptic of long standing who had suffered considerable deterioration. Since 1926 he had averaged about four convulsions per month, and these were frequently followed by periods of confusion and excitement. He continued to hear God's voice, he was frequently heard talking to himself in a religious vein, and he was very irritable. A psychometric examination showed his mental age to be seven years, three months.

Physical examination revealed the typical classic picture of oxycephaly, as described by Fletcher. The head was tower-shaped, being long from vertex to chin, the forehead high and sloping to a point at the bregma, where a broad ridge was felt. The intertemporal diameter was relatively narrow and the supraciliary and temporal ridges were feebly marked. The hard palate was high, narrow, and sharply arched. The mandible was prominent. A moderate bilateral exophthalmos was present. Movements of the eyeballs were normal. The pupils were irregular, and the right was slightly larger than the left. They reacted very sluggishly and only to a small extent to light. The fundi showed chalky white discs, indicative of optic atrophy. Vision was greatly impaired. There was no

Fig. 2. Case I. Note the lack of suture lines, the peak with thinning of the calvarium at the bregma and the prognathous jaw.

Fig. 3. Case II. Note the high head and the "keel" in the region of the bregma.

webbing of fingers or toes, and no evidence of other pathology in the osseous system.

Blood counts and urine analyses were essentially negative. Blood Kolmer and Kahn tests were negative. Non-protein nitrogen, blood urea, and blood sugar were within normal limits. The blood calcium was 7.7 mg. per 100 c.c., and the phosphorus 4.92 mg. per 100 c.c. Examination of the spinal fluid revealed a negative Kolmer, 2 cells per cubic millimeter, and a colloidal gold curve of 0012210000. A roentgen examination of the skull confirmed the diagnosis of oxycephaly. The sutures were not discernible. The calvarium was thinned out, especially in the frontal area. The air sinuses were very small. The sella turcica was eroded and widened. The middle fossa of the skull was pushed down, lying on a level with the posterior fossa. Roentgen examination of the remaining bones of the skeleton revealed no abnormalities.

Case II. G. H., a colored male, aged thirty-four, was admitted to St. Elizabeth's Hospital on June 27, 1933. Family history was essentially negative in regard to any possible skull deformity in either parental line. The usual story of a severe blow upon the head in infancy, not followed by any complications, was elicited. He had the usual diseases of childhood, but none of these was of marked severity. As a child he was slow and backward in learning in school and much below the average. He denied syphilis, but admitted gonorrhea at the age of sixteen, and a few weeks prior to the onset of his present illness.

In May, 1933, he began suffering from a urethral discharge and was being treated in one of the city clinics. He complained of a headache, that a girl was casting a spell over him, and he became so confused and violent it was necessary to admit him to the psychopathic department of the municipal hospital June 13, 1933.

On admission the patient appeared acutely ill physically, and presented the mental picture of a delirioid reaction, which cleared up gradually with improvement in his physical condition. He had an acute gonorrheal urethritis, a marked anemia, and a marked systolic mur-

Fig. 4. Case II. Note the absence of suture lines, thin calvarium and peak at the bregma. Also note the leveling of the three cranial fossae and the underdevelopment and flattening of the frontal air sinus.

mur over the aortic area of the precordium. Several transfusions and supportive therapy cured the patient of his acute illness, the exact diagnosis of which was never positively determined although it was suggestive of a septicemia. No organism could be cultured from the blood after numerous attempts.

The skull revealed a typical oxycephaly. The head was unusually high and the bitemporal diameter narrow. The forehead was high and sloped gradually to a keel-like projection in the anterior portion of the sagittal suture. The supraorbital and temporal ridges were feebly marked and the malar regions of the face were flattened. The lower jaw was prognathous in type. There was a bilateral exophthalmos so marked that the eyeballs could be dislocated. Pupils were equal and regular, and reacted promptly to light and accommodation. A moderate bilateral optic atrophy was present. Perimetric examination revealed a diminution in the size of the visual fields, most marked in the nasal field on each side. Psychometric examination showed a mental age of eight years.

Blood count on admission revealed a hemoglobin of 15 per cent, red blood cells 950,000 per cubic millimeter, and a leucocytosis, all of which returned to normal levels after several blood transfusions. Non-protein nitrogen, creatinine, and sugar were within normal limits. A smear from the urethra demonstrated gram-negative diplococci, both intracellular and extracellular. Urine analysis was essentially negative except for the presence of pus cells. Blood Kolmer and Kahn reactions were negative. The spinal fluid revealed negative Kolmer, protein content 1 plus, and a gold curve of 0000221000. Blood calcium was 7.12 mg. per 100 c.c., and phosphorus 3.18 mg. per 100 c.c.

Roentgen examination of the skull confirmed the clinical diagnosis of oxycephaly. Suture lines were absent, and the calvarium was thin over the frontal and parietal regions. Marked convolutional digitations of the inner table were found. The frontal sinus was rudimentary and flattened in its anteroposterior diameter. There was widening of the floor of the sella turcica and erosion of the posterior clinoid processes. The region of the bregma was elevated. Roentgenograms of the long bones displayed no abnormalities.

SUMMARY

(1) Two cases of oxycephaly associated with feeblemindedness are presented. They reveal the classical triad of signs—tower head, exophthalmos, and blindness with optic atrophy.

(2) The feeblemindedness in both cases and the epilepsy in one are probably due to brain damage secondary to chronic intracranial hypertension dependent upon the oxycephaly.

(3) The diagnosis was confirmed by roentgen examination of the skull, which revealed ossification of the sutures.

(4) Blood calcium was decreased in both cases, perhaps indicative of metabolic dysfunction, the exact nature of which is hypothetical.

(5) Oxycephaly is a condition, either congenital or acquired, characterized by a unique deformity of the skull dependent upon the premature synostosis of the skull sutures and usually associated with exophthalmos, impaired vision, and optic atrophy.

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CINERADIOGRAPHY*

By RUSSELL J. REYNOLDS, C.B.E., M.B., M.R.C.P., D.M.R.E.

IN May 1921 the writer initiated some experiments with a view to bringing the principle of cinematography when used in connection with X rays to a practical issue. The idea had occurred to other workers previously. As early as 1896 or 1897 some experiments were conducted by the late Dr. John Macintyre, of Glasgow, and much later by others abroad; but up to this time, as far as could be ascertained, no great success attended their efforts when experiments were conducted on the human body. This new method of examining the movements of joints and organs of the living body offers an entirely new field for observation and research, and is a very notable addition to our present methods of X-ray diagnosis. To be of value the method must be a true cinematographic rendering of movements. The operation must be relatively simple, inexpensive and expeditious, if it is ever to be adopted universally as a routine in X-ray examination.

There would appear to be only two methods from which to choose:

(1) The direct method, by passing a band of film in front of the patient and allowing X rays to act directly on it as in the production of an ordinary skiagram, and

(2) The "indirect" method, by taking a photograph of the screen image with a cinematograph camera.

On account of the costliness and lack of practicability of the direct method, my attention was directed to the indirect method. As no literature could be found on the subject, progress was necessarily slow and laborious. Many serious difficulties had to be overcome before even a measure of success was attained.

Details of the experiments conducted from 1921–1925 are set out in a thesis presented to the University of Cambridge in September of the latter year. Experiments conducted at a later date were described in a paper communicated to this journal[1] and in a paper read at the 28th Annual Meeting of the American Roentgen Ray Society at Montreal, Canada, in September, 1927.[2]

To achieve success certain essential conditions have to be fulfilled.

(1) It is necessary to obtain a sufficiently brilliant screen image to record on a cinematograph film in the fraction of a second. This of necessity means that one must employ an X-ray plant giving sufficient output, and an X-ray tube capable of withstanding the heavy currents that are necessary for the production of a powerful beam of X rays, for it is only with considerable intensity of radiation that a sufficiently brilliant screen image can be obtained. The camera lens must have as large an aperture as possible to allow the maximum amount of light to pass through it from the screen and reach the photographic film. The film employed must be sensitive to the particular wave-length of light emitted from the fluorescent screen used.

(2) It is necessary to cut off the direct beam of X rays passing through the screen, so that only ordinary light can reach the film.

(3) Protection must be provided for the patient, so that he will not suffer from undue exposure to radiation.

It has only recently been possible to fulfil adequately some of these conditions; especially I would mention those under heading (1).

Partial success was obtained as early as 1925, when I obtained movements of a thorax and various joints of the human body, with a relatively long exposure. Since that date, more particularly during the last few years, improvements in X-ray apparatus and the introduction of the self-

* Reprinted with permission from the *British Journal of Radiology*, July, 1934, 7, 415–424.

protective type of X-ray tube have made it possible to get sufficient power with greater safety. Recent improvements in the manufacture of fluorescent screens and films with more sensitive emulsions have enabled me to make use of the powerful radiation obtainable.

The question of the safety of the patient also has been solved. In the early work, the writer succeeded in reducing the exposure to a minimum by exciting the X-ray tube only during the period of time that the camera shutter was open. The idea of a synchronized shutter to cut off automatically the continuous beam of X rays from the patient and screen was discarded, as the load on the tube would have been too heavy. The early devices for synchronizing the tube excitation with the opening of the camera shutter have been progressively improved, and a very simple device is used now, which makes the process thoroughly practical and ensures perfect working.

A very large amount of experimental work had to be done before the present results were obtained. To give an idea of the possibilities of this method, a first-class cinematograph film of a dried skull was obtained with 60 frames a second; that is to say each exposure was 1/120th of a second. A 16 mm. cinematograph camera was used during the later experiments, thus ensuring a process simple enough to become a routine practice in hospitals and institutions, and well within the reach of every radiologist. The apparatus occupies only a very limited space, and can be accommodated in any X-ray department. It can easily be operated by one person. It is wholly unnecessary to have a long length of film; in actual practice, a small length can be made up into a band and run through the projector continuously, and cases studied at leisure. It is obviously only necessary to give a sufficiently long exposure to obtain a record of the movements desired; this can be done in most

Fig. 1. General lay-out of the apparatus.

cases in a very few seconds on a piece of film a foot or more in length. The resulting negative can be printed off again and again on a length of positive film.

The expense of production is small and much less than would be the case if a standard-sized film were employed. A non-inflammable acetate film is used, so there is no necessity for any special protection against fire: it does not come under the special regulations of the County Councils. The image can be projected either natural size or enlarged as desired.

In 1933, mainly owing to the fact that great improvements had been made in X-ray apparatus including fluorescent screens, in the construction of photographic lenses and in the production of sensitive films, I began a new series of experiments. First it was necessary to determine which of all the available fluorescent screens was best for the purpose, and which photographic film should be employed.

Photographs were taken with all the available screens in turn on a series of photographic films. A quarter-plate Kodak camera fitted with a 6.5 aperture Cooke lens was employed. In this way practically every likely type of photographic film was tested. It was found that the best combination was an Ilford SX screen used in conjunction with a Gevaert orthochromatic film.

It will thus be seen that the best results were obtained when using a screen emitting a bluish light with a film sensitive to this particular wave-length of light. Screens emitting a yellow-green fluorescence used in conjunction with a supersensitive panchromatic film proved to be much less satisfactory.

Having ascertained the foregoing facts, a 16 mm. Victor Cinematograph camera fitted with a Dallmeyer lens aperture 1.5 was used, and a 20 K. W. Philips Metalix tube was installed in order to provide an ample margin of power.

I then had an interview with Messrs. Ilfords, and at my suggestion they very kindly made a special intensifying screen, emitting a bluish fluorescence, which was at least 50 per cent faster than the SX screen they had previously manufactured. This screen gave some afterglow, but this did not appear to affect the results adversely. They also prepared a 16 mm. cinematograph film coated with X-ray emulsion. This combination produced extraordinarily good results. The question of the most suitable developer received consideration, and after many experiments the following formula was adopted:—

Metol	5 grams	Solution I.
Hydroquinone	8 "	
Sodium Carbonate (Cryst)	100 grams	Solution II.
Sodium Sulphite	" 100 "	
Potassium Bromide	" 5 "	
Water to 1,000 cc.		

The optimum time for development was found to be eight minutes at 65° F.

Attention was now directed to the type of lens used. A Zeiss lens 0.85 aperture was obtained by Messrs. Dallmeyer; this lens had a focal length of 5.5 cm. It was found necessary to place it at 72 in. from the screen in order to cover a field of 10 in. by 18 in. It was fixed experimentally in front of a Victor ciné camera, and exposures were made on a Gevaert film with the Ilford special screen and the dried human skull. (The Gevaert film was used, as it was thought the X-ray film was too rapid to indicate fine difference.) The camera was driven by its own mechanism. To obtain a satisfactory comparison between this lens and the Dallmeyer lens of 1.5 aperture, the Dallmeyer lens was placed at 36 in. from the screen in order to cover the same field. When the resulting films were developed, the Zeiss lens was found to yield much better results. The improvement was so marked that it was now felt a stage had been reached when experiments could be carried out with living subjects, and for the first time a good film was obtained of an adult thorax at the rate of seven pictures per second.

An attempt to photograph the stomach and duodenum after the administration of

a barium meal was not successful, although good films of other parts of the body were easily obtained.

Messrs. Zeiss obtained for me a short focus lens with an aperture of 0.85. A field of 10 by 18 in. could be covered with this lens at 60 in., whereas with the long focus Zeiss lens the distance was 72 in., and with Dallmeyer 1.5 lens, 36 in.: the short focus 0.85 lens was found the best for the purpose and chosen for all future work. It had been made as an experimental lens and had no adjustable mechanism; it was therefore fitted with a micrometer screw adjustment and permanently incorporated with a Victor 16 mm. turret model camera by Messrs. Dallmeyer.

Comparative tests were carried out at this stage between the one-valve power-unit already used and a four-valve power-unit. For this purpose, films were taken under identical conditions with each unit. The one-valve unit unexpectedly gave the better results.

In the case of the 0.85 aperture short focus lens, difficulty was experienced in obtaining an accurate focus of the screen image. A card marked out in black and white squares was placed in the position occupied by the screen, illuminated with a hand lamp and focussed directly on to a piece of ground celluloid placed in the camera in the position of the film. It was found that, however accurate the focus of the image appeared to be, on development of the actual photographs subsequently taken by X rays, the negative was distinctly out of focus. This was due to the fact that the wave-length of the light emitted by the screen when exposed to the rays was not the same as that obtained from the focussing card illuminated by the lamp. The following procedure was therefore adopted for focussing. A clear-cut metallic grid was placed just behind the fluorescent screen, and this was used as an object to be photographed when illuminated by the rays. At first a rough focus was obtained

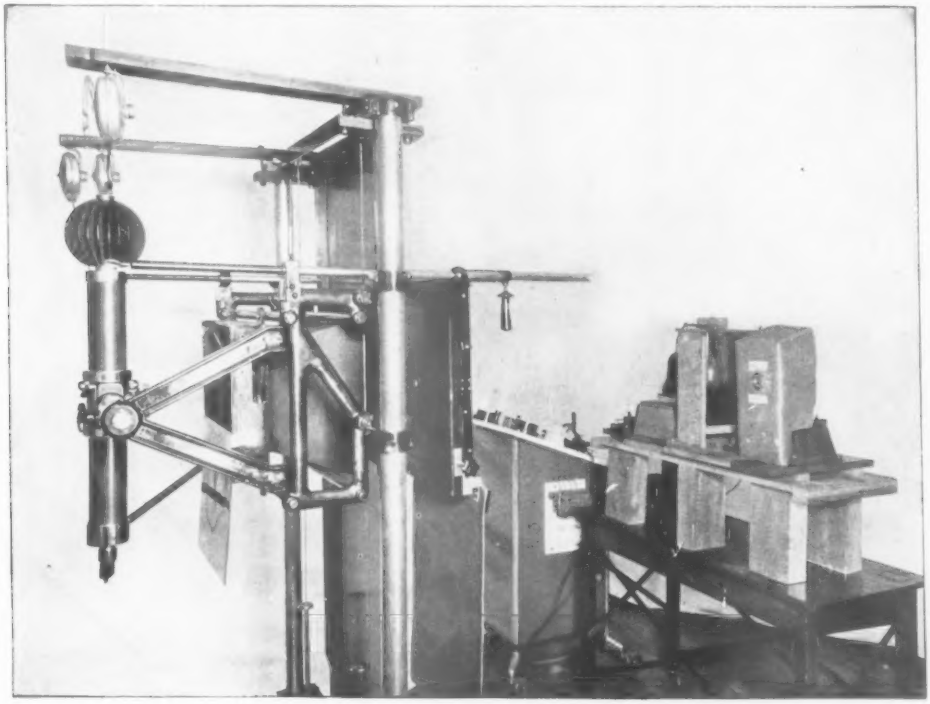

Fig. 2. View showing the X-ray tube and the lead shield protecting the camera.

with the card mentioned above; fine adjustments were then made with the lens micrometer screw on each side of a central position obtained with the card. A series of exposures were made, each marked for identification on a length of film. This enabled the most accurate position to be decided.

Experiments were being conducted under the most suitable working conditions available, and living subjects were employed, so the synchronising switch was incorporated in the circuit. In order to understand the design of the switch it will be necessary to mention some details of the working and construction of the camera mechanism.

The camera is made to take seven exposures for each revolution of the driving spindle, and the shutter of the camera opens and closes seven times uniformly during each revolution. In this way if one revolution is made per second, each of the pictures taken receives an exposure of 1/14th of a second. The length of exposures can be exactly regulated by varying the speed of the driving spindle. At all speeds, however, the ratio of the time of exposure to the time taken by the film to get into position when the shutter is closed will be the same. The contacts of the synchronising switch are arranged so that the X-ray tube is only active during the period of time that the camera shutter is open. The patient, therefore, is only subjected to 50 per cent of the radiation that he would receive if the X-ray tube was working continuously. This is a most important point, and it is just this that makes it possible to give a sufficiently long exposure without any undue risk to the patient from excessive radiation. It is clear that the strain on the tube is at the same time greatly reduced.

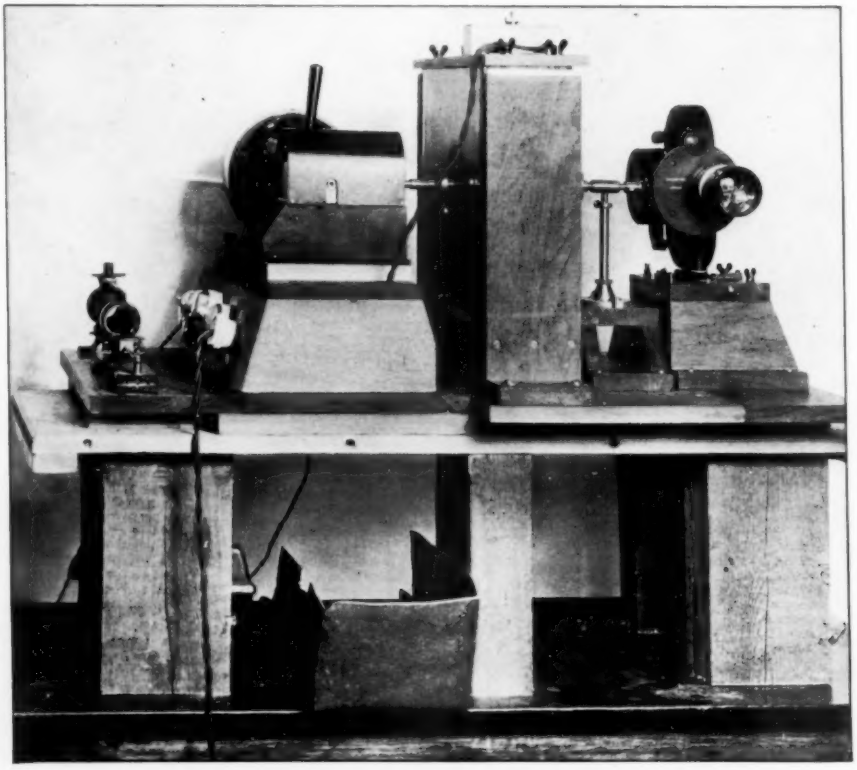

Fig. 3. Photographic unit with the synchronising switch.

The synchronising switch takes the form of a rotary contact breaker. It consists of

a disc of keramot, 10 in. in diameter and 1 in. thick. The axis of this disc is continuous with the driving spindle of the camera mechanism. The lower half of the disc is immersed in a glass tank of pure paraffin oil. Around the circumference seven phosphor-bronze strips of equal length are arranged, equidistant from one another. They are slightly longer than 1/14th of the circumference of the disc, and they project slightly from the surface of the disc itself. The front ends of these are connected with a flat brass ring, 7 in. in diameter, let flush into one side of the disc. Permanently engaging with the brass ring is a two-leaved spring copper contact. This is placed beneath the surface of the oil. A copper lead passes from this to a terminal at the top of the disc framework. The phosphor-bronze strips arranged on the circumference of the disc make contact in turn with another two-leaved spring copper contact when the disc is rotated.

The contacts on the disc are so arranged that electrical connection is only made during the time the camera shutter is open, and so during this time only is the X-ray tube excited. To avoid vibration, a small universal joint is put into the rotating axis just before it joins the camera mechanism.

A dog clutch is fitted on each side of the disc mechanism, so that the latter can be disconnected both from the motor drive and the driving spindle of the camera. The switch is driven by an electric motor, the speed of which can be regulated by resistances. The number of revolutions per second are ascertained by a tachometer connected with the motor. A switch is included in the primary circuit, so that the current can be short-circuited, thus enabling the apparatus to be used in the ordinary way for screen examinations previous to taking a cinematograph film.

Exposures of various parts of the human body have been made; the joints, movements of the heart and thorax, the act of swallowing and the passage of an opaque meal through the esophagus, stomach and duodenum with satisfactory results in every case.

The following is a summary of the conditions employed:—

1. Victor Turret model. 16 mm. camera.
2. Zeiss 0.85 short focus lens.
3. Ilford special screen.
4. Ilford X-ray emulsion film.
5. Phillips 20 K. W. tube.
6. Tube filtration, 0.5 mm. Al.
7. Current constants, ma. 70, K. V. 120 (maximum).
8. Distance from anticathode to the screen varies.
9. Distance from the screen to the front of the camera, 63 in.
10. Field covered, 10 in. by 18 in.
11. Camera protected by a lead shield, 3 mm. thick.
12. Synchronising switch used in circuit.

It is now possible to conduct X-ray cinematographic examinations as a routine practice, without subjecting the patient to any greater risk than he would run when examined by X rays in the ordinary way. A total exposure of 16 seconds to one area has been given; this has been repeated within a few days without any ill effects to the patient at all.

The principles adopted and methods employed do not differ essentially from those used in my early experiments of 1925. The greater measure of success recently obtained is due to the improvements made in apparatus since that date.

There would appear to be a large and varied field for research in this new method of X-ray diagnosis; it is at present impossible to estimate the potentialities. It should prove, for example, of immense value in investigating lesions of the lungs and pleurae, especially after lipiodol injections, or in cases where artificial pneumothorax has been induced. As regards movements in the alimentary tract in pathological states, the advantage of being able to study such movements indefinitely after the administration of an opaque medium is obvious. In orthopaedic lesions, the range

of movements in limbs and joints can be observed after an injury, and in those cases where an operation has been performed, progress can be recorded and studied at intervals.

Ordinary X-ray examination has been regarded for many years as a recognised and even essential method of investigating the condition of the cardio-vascular system. Cardiologists almost invariably include such an examination as a routine when analysing their cases; up to the present time, however, the chief use of X rays has been to enable them to check up their physical signs as regards the size and position of the heart, the condition of its cavities and the state of the great vessels; it must be admitted, however, that X rays have so far contributed very little to our knowledge of the functioning of the organ.

The cinematographic method of investigation will, I believe, add greatly to our knowledge of the functioning of the heart, especially in the various irregularities arising in cardiac lesion, for instance in a sino-auricular block. I propose shortly to demonstrate the value of this method for cardio-analysis by showing a slow motion film, correlated with graphic records of the heart's action.

Apart from the clinical uses mentioned, there are of course other fields of usefulness, for instance, the investigation of physiological problems where use may be made of opaque media injected into the circulatory system in animals.

I will now summarise the advantages which the present method offers:

(1) The cinematograph method described enables one to obtain a rapid, inexpensive and permanent record of the functioning of active organs.

(2) The continuous "band" enables one to study movement for an indefinite period, whereas an ordinary screen examination can, for various obvious reasons, only be carried out for a very short period.

These advantages are specially obvious in organs such as the heart, where one wants to examine several different parts in a state of movement at the same time.

(3) The permanent records of movements may be used for:

a. Purely diagnostic purposes.
b. Comparison with former records to watch the effects of treatment or the progress of a pathological condition.
c. Teaching purposes.
d. Transmission abroad or elsewhere, either for the purpose of obtaining specialists' opinions as to the nature of the case, or for information purposes as to the condition of the patient in the past.

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THE EFFECT OF ROENTGEN THERAPY UPON TUMORS OF THE KIDNEY*

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MALIGNANT tumors of the kidney parenchyma comprise a group of neoplasms which are difficult to classify pathologically on account of the varied histological findings. The difficulties that further surround these tumors are exemplified by the varied nomenclature given the same type of tumor. While the literature refers to numerous types of malignant tumors of the kidney, an analysis for the radiologist's use shows that they can be classified under three groups: the hypernephromata, the adenocarcinomata, and mixed tumors. The two former groups are commonly found in patients between forty and sixty years of age, while the latter are usually found during infancy and childhood.

This paper comprises first, a brief discussion of the laws governing cellular radiosensitivity; second, a discussion of the symptomatology and pathology associated with kidney tumors; third, a discussion of the application of the laws of radiosensitivity to malignant kidney tumors and, finally, a report of the changes found in mixed tumors of the kidney after irradiation.

The laws governing cellular radiosensitivity have occupied considerable attention. The accumulated clinical, pathological and radiological observations concerning radiosensitivity have been very beneficial in the treatment of different types of tumors. There is, however, very little pathological investigation to determine the tissue changes in kidney tumors following irradiation.

Stewart[5] has defined radiosensitivity as that combination of circumstances resistant in a tumor or the host which permits marked or total local tumor regression under doses of radiation sufficiently small to preserve the integrity of the tissues of the host. Although the actual mechanism of radiation destruction is somewhat vague, considerable information has accumulated showing that different cells show different degrees of sensitivity to roentgen therapy.

Many general factors have to be considered when radiosensitivity of tumor cells is discussed. If the patient is not in a good general condition, the results of irradiation are poor. All investigators are agreed that anemia and cachexia impair the effect of the therapy. When the patients are undernourished, they are usually made worse by irradiation and the tumor is unchanged. Fatty tissue offsets the desired effect of irradiation. Actively associated infection interferes with roentgen therapy. An overproduction of secretion such as mucin is also antagonistic. Indolent connective tissue, the result of successive inadequate treatments, adds greatly to the resistance. Ewing feels that this is a strong argument in favor of the view that the destruction of tumor cells by irradiation results largely from a normal inflammatory tissue reaction. These are a few of the general factors that frequently interfere with successful irradiation, although the tumor cells are of a sensitive type.

The highly radiosensitive cells are very embryonal. They are poorly differentiated. It is a delicate cell that apparently lacks a tough membrane. It is a cell with a rich fluid content and does not have the tendency to form fibrous tissue. The characteristics of the origin cell apparently have a great influence upon its sensitivity. For example, the tumors of lymphoid origin are easily destroyed by irradiation, while those of nerve origin are very resistant. The former represents a cell with a short life

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cycle, while the latter represents one with a long cycle. Stewart feels that a high metabolic rate may be assumed for rapidly growing anaplastic tumors, but unfortunately not all such tumors are sensitive to irradiation and some are highly resistant. It seems certain that embryonal appearing anaplastic tumors made up of short life cycled cells and coming from lymphoid or similar tissues are the most radiosensitive.

Since the symptoms associated with malignant tumors of the kidney in the adult are so well known, I will confine my brief discussion to those in infants and children. During the early development, these growths in children are asymptomatic tumors. There were no reported cases found in the literature in which the diagnosis was made before an abdominal mass had been palpated. When the diagnosis is made the growth is usually far advanced. The first indication of disease in most cases is an enlargement of the abdomen discovered by the mother or nursemaid. While hematuria is occasionally referred to in children, it is very much less frequent than in the kidney tumors of the adult. The usual absence of hematuria associated with these tumors is not so much a characteristic of the growth as it is due to the tumor occurring during infancy and childhood. At this period, the capsule and blood vessels of the kidney are much more elastic and so allow greater expansion from tumor growth without causing rupture of the blood vessels. When the tumors are large sized, symptoms become evident. These are the result of pressure upon adjacent organs or tissues.

In the differential clinical diagnosis of kidney tumors in children, neoplasms of the liver, spleen, adrenal, ovary, retroperitoneal soft tissues and intestine have to be eliminated. Although any symptomless tumor mass in the upper abdomen in infants or children usually justifies the diagnosis of malignant kidney tumor, it cannot be definitely made until tumors in the above mentioned organs have been eliminated. Pyelographic studies are usually sufficient to identify the renal tumors. Kretschmer[4] emphasizes the importance of knowing that intravenous urography may be misleading. Like Kretschmer, I have studied an infant patient in whom intravenous urography showed an abnormal pyelogram with the lower and middle calyces absent on the tumor side. On the opposite side the pyelogram was normal. On account of an indefinite outline of the pelvis, a pyelogram was made with a catheter in the ureter. This pyelogram showed a normal kidney pelvis and complete filling of the calyces. This case, like Kretschmer's, illustrates the importance of not placing absolute confidence in intravenous pyelograms. Occasionally, in spite of the utilization of all available methods, a differential diagnosis cannot be made. In these cases an exploratory operation after irradiation is indicated. When an exploratory procedure is decided upon, this should be done with intent to remove the tumor and not to do a biopsy. Biopsies in the embryonal types of tumor stimulate growth and metastases.

The follow-up reports on tumors of the kidney indicate that the prognosis is much poorer in children than in adults. Schippers reviewed 145 case reports, and found that only 4 patients had lived four years after nephrectomy. White reported a patient apparently doing well with no evidence of metastasis six years after nephrectomy. Wollstein[7] reported a patient, alive and well, thirty-four years after removal of a kidney tumor. These are a few of the exceptional results. The usual follow-up on groups of cases report death during the first year after removal of the tumor from metastasis or extension. The reported results in practically all of these tumors is exceedingly poor when surgical removal alone is employed.

HYPERNEPHROMATA

When the cytological findings in malignant tumors of the kidney are analyzed from a radiosensitivity point of view, they show the greatest diversity of cellular arrangement. The hypernephroma group show a tumor to be well circumscribed, a

result of condensation of the surrounding tissues. The tumor tissue has a yellowish fatty appearance, is prone with the release of tension to bulge somewhat and usually shows some degree of hemorrhagic necrosis or cyst formation. Rarely is the tumor subdivided into lobules by bands of fibrous tissue, complete encapsulation is occasionally met with, but it is not uncommon to find in remnants of a capsule-like structure evidence that complete encapsulation had existed at some stage in the development of the tumor. A portion of the growth may be covered by a thick, dense, fibrous capsule which is almost invariably and completely wanting at the point where renal invasion has occurred.

The prevailing neoplastic cell, while presenting slight variations in size, is of the large polygonal type, consisting of a small nucleus surrounded by a clear vacuolized cytoplasm. The cells nearest the center show the usual signs of retrogressive changes. The predominating cells in hypernephromata show the greatest diversity of arrangement. Areolar, cordon, tubular, adenomatous and papillary types have been noted in the same tumor. It is obvious that any classification based upon the arrangement of the cells alone must prove unsatisfactory.

When the laws governing radiosensitivity are applied to the pathological findings in hypernephroma, it is evident that many of the characteristics should be antagonistic to irradiation. First, this tumor has an excessive amount of intracellular fat; second, cystic degeneration and necrotic changes are frequently seen, and third, the predominating cells are large, well outlined, and fairly well differentiated. Although the cells are malignant, they present considerable histological evidence of self-control. These findings undoubtedly must tend to offset the beneficial effect desired from irradiation.

Usually there are associated areas in these tumors with collections of anaplastic cells that appear to lack antagonistic features. In these areas, the cells are much smaller, they are embryonal in appearance and present most of the characteristics seen in a radiosensitive tissue. These areas probably represent early stages in the development of the large polygonal vacuolated cell so commonly found in hypernephroma. They are the cells which preoperative irradiation should destroy. The observations of Bumpus[1] on the response of metastatic hypernephroma and those of Waters, Lewis, and Frontz[6] upon primary tumors show that radiosensitive cells are present in these tumors. It is also evident that the change and the reduction in size of the tumor from irradiation is directly proportional to the amount of this type of tissue present.

ADENOCARCINOMATA

The adenocarcinoma group of kidney tumors, which probably take origin from the tubule epithelium, give very little cytological evidence of radiosensitivity. In these tumors the predominating cell is fairly well differentiated. They are usually cuboidal or low columnar types with a fairly definite outline. The arrangement is usually in irregular glandular and tubular formation, depending upon the plane in which the section is cut. The vascularity varies with the degree of differentiation. Except for the few small embryonal, anaplastic appearing cells that are seen scattered among the larger cells this tumor appears radioresistant. This tumor should be irradiated before surgical removal. The cellular findings, however, give very little indication that irradiation will have destructive effect.

MIXED TUMORS

Although the mixed tumors of the kidney usually occur during infancy or childhood, and are the commonest tumors at that period, they occasionally occur during adult life. Kilbane and Lester,[3] in a careful research of the literature, found 15 reported cases of mixed tumors in adults and added 1 to the list. Although in discussing this group of cases in adults, the authors feel that some may not have been true embryomata or mixed tumors.

Table I

Author	Age	Sex
Hyman	22	Female
Muns	34	Female
Kocher and Laughans	35	Female
Albarran and Imbert	37	Male
Nicholson	40	Female
Jenckel	43	Female
Keefe and Palmer	44	Female
Hasner	45	Male
MacDonald	50	Male
Rohde	52	Male
Hedren	54	Male
Maas	55	Female
Baurmann	59	Male
Thatcher-Fulmer	59	Female
Davis	59	Male
Kilbane and Lester	48	Male

(Tabulated by Kilbane and Lester)[3]

The varied nomenclature applied to this type of tumor is as varied as there are varieties of histological findings. The terms embryoma, sarcoma, carcinoma, myxoma, myxosarcoma, teratoma, adenocarcinoma, adenosarcoma and Wilm's tumor, have all been used to designate the mixed tumor group. These terms exemplify the numerous ideas expressed in the literature about this growth. Occasionally these terms may be expressive of the entire tumor, but in many instances the observer has studied an insufficient number of areas in a given tumor to know the true nature of the tissues. In some tumors the sarcomatous nature is so prevalent that only a very small area shows growth of tissues representative of the other primary layers. This wide variation in the histological findings adds to the perplexity. They all appear similar yet each one has some characteristic that is different. For this reason it is better to classify them collectively as mixed tumors of the kidney with a qualifying remark to specify the predominating cell.

The microscopical appearance of the non-irradiated mixed tumors, unlike most kidney tumors, shows a wide variation. One needs only to refer to the terms used in the literature in classifying these tumors to realize the diversity of histological findings. Although the predominating growing malignant tissues in mixed tumors of the kidney are anaplastic, round cells and fairly well differentiated epithelial cells, it is not uncommon to find smooth and striated muscle, fat, cartilage and bone. In many specimens the diagnosis is descriptive of the prevailing cellular type.

The sarcomatous cells common to these tumors range from the small round type to the more mature elongated spindle cell with wide variations in intermediate forms. The areas with excessive growth usually have very little stroma or supporting tissue. The vascular network ranges from the immature early formed or forming vessels to the maturely developed types, as seen in normal tissue. The more immature the predominating cells, the more numerous are the young blood vessels. The small round cells which are usually grouped in large islands are very embryonal in appearance. They take the stain deeply and although variable in different areas, cells with mitotic figures can be identified. When these small round cell areas merge with those of the more mature spindle type, different intermediate stages of development are seen.

The epithelial cells in these tumors are also collected into groups. They are usually adjacent to and sometimes invade the sarcomatous tissue. They show varying degrees of differentiation. They range from different sized irregular cells to definite cuboidal and low columnar types. The degree of differentiation of the epithelial cells is usually moderately advanced. The tendency in most sections made from these tumors is an epithelial cell with differentiation indicative of moderately advanced self-control. They appear as those seen in slowly growing tumors. This observation on the epithelial cells is usually common to all the mixed tumors whether the epithelial or the sarcomatous tissue structures predominate the tumor. In many areas the epithelial cells are in duct-like or acinar formation. They are not unlike the arrangement seen in the uriniferous tubules of the kidney. In general, it is usually evi-

dent that the sarcomatous tissue in the mixed tumors appears embryonal and radiosensitive while the carcinomatous tissue appears much more radioresistant.

Five mixed tumors of the kidney were irradiated before considering surgical removal. They were all greatly reduced in size after roentgen therapy. In 3 of the patients the clinical improvement was so marked that the parents refused to have the tumors removed. One of these patients died in six months from recurrence and metastasis. Another died in one year, and the third is still living, six months after irradiation. Two of the patients on the service of Dr. Randall at the Hospital of the University of Pennsylvania permitted surgical removal of the kidney and tumor after roentgen therapy. These specimens have been studied to determine the tissue changes that have been the result of irradiation.

Case 1. M. T., a white female, was admitted to the Hospital with a chief complaint of a mass in the abdomen. A diagnosis of left renal tumor was made. The patient was referred to the radiological department for therapy before considering surgical removal.

The tension used at the poles of the roentgen tube was 200 kv. with a filtration of 2 mm. Al and 0.5 mm. Cu. The focal skin distance was 50 cm. The intensity of the current traversing the tubes was 4 ma. The irradiation was directed over the kidney region. There were two portals each 8 × 16 cm. with 800 r at each portal. The time of application was seventeen days. A second short series was given two months later with two days' application and 200 r was applied. The lesion responded very much better to the first treatment than it did to the second. The mass was reduced about 40 per cent in size. The kidney and tumor were removed transperitoneally.

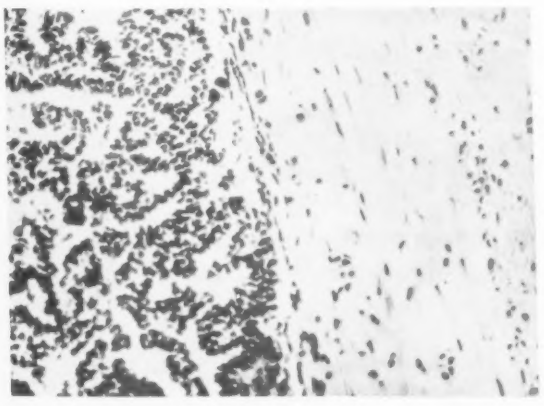

Fig. 1. Photomicrograph illustrating the resistant epithelial cells which were not destroyed by roentgen therapy. Adjacent to the epithelial cells the fibrous displacement of the sarcomatous tissues is illustrated. In the meshes of the fibrous tissue an occasional malignant-appearing small round cell still remains.

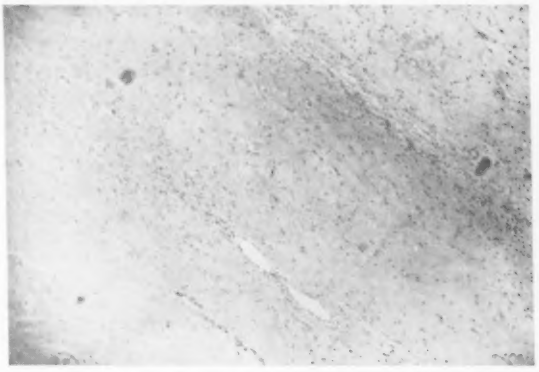

Fig. 2. Photomicrograph of the fibrous tissue which has completely displaced the sarcomatous tissue.

The specimen consisted of a kidney and tumor which measured 13 × 9 × 8 cm. The surface was smooth save for a few tags of fatty and fibrous tissue. On account of low, rounded elevations, the tumor was lobulated. The specimen on section was firm with irregular blood streaks and varying sized hemorrhagic cysts and a number of soft pale granular necrotic appearing areas. These involved less than one-third of the tumor. The remainder of the tissue was pale and appeared fibrous and semifibrous. Attached to the smaller pole compressed kidney parenchyma was seen. The tumor had the appearance of separation from the kidney.

Many sections were made for microscopical study. These were taken from different areas and in different planes. The essential findings in these sections were first, epithelial cells, second, small clumps and scattered small round cells, and third, a diffuse fibrosis which was very abundant in some areas. The epithelial cells were mostly the mature, well formed low columnar type, in acinar or partial acinar and tubular formation. These groups were separated by a fine fibrous stroma. The small round

cells, like those seen in lymphosarcoma were malignant in appearance but separated into small islands by dense fibrous tissue. In some sections neither epithelial nor round cells were seen; dense fibrous tissue was the only structure.

The patient made an uneventful recovery after nephrectomy. A roentgen examination of the chest six months after removal of the tumor revealed extensive tumor metastasis in the lungs. The patient died six weeks after this examination.

Case II. J. D. The patient, a white female, aged ten, was admitted to the Hospital on the service of Dr. Joseph Stokes with a chief complaint that the abdomen was increasing in size. The child had previously been examined at another institution and diagnosed embryonal adenocarcinoma of the kidney with metastasis to the lungs.

The patient was sent to the radiological department of the University Hospital for roentgen therapy before considering surgical removal. The tension used at the poles of the roentgen tube was 200 kv. with a filtration of 2 mm. Al and 0.5 mm. Cu. The intensity of the current traversing the tubes was 4 ma. The irradiation was directed from the neck to the tuberosity of the ischium. There were four portals, each 13 × 17 cm. with 800 r at each portal. The time of application was twenty-seven days. This was followed by surgical removal of the kidney and tumor. The above treatment was again started eighteen days after the operation. The time of application was eleven days. A third series was given six months after the operation. This required twenty-eight days. The chest received 1,600 r at each portal and the abdomen 800 r at each portal. A subsequent examination thirteen months after the last series revealed metastatic lesions in the lungs. The chest was then treated through one portal anteriorly and one portal posteriorly. In twenty-six days 1,600 r was applied to each portal. This was followed with a one portal series over the liver in which 1,200 r was delivered in thirteen days. This treatment reduced the tumor to about one-half the original size. A transperitoneal nephrectomy was performed.

The specimen consisted of a kidney and tumor. It was roughly pear-shaped. It measured 11 × 7 × 6 cm. The tumor was a large nodular mass covered with a grayish pink capsule. Within the capsule at the smaller pole, a thinned out remnant of kidney tissue could be recognized. On section the tissue bulged slightly. The color ranged from grayish white to grayish pink. Here and there varying sized cysts were seen, some contained gelatinous material which was blood tinged, while others contained pure blood. Within the thick capsule at the smaller pole, remnants of kidney tissue were separated from the mass by a fibrous capsule. Portions of the tumor were moderately firm with scattered areas of softening.

The microscopical sections were made from different areas in different planes. The sections were made up of three types of tissue which varied in amount in different sections. In some areas the epithelial cells predominated. They presented themselves in groups separated from small round cells and fibrous tissue. The epithelial cells were excessively the low columnar type arranged to form tubules or acini. There were small groups of the same type of cells which were irregular in form and without definite arrangement. The majority of these epithelial cells were well differentiated and appeared to be under control. In many sections large plaques of dense fibrous tissues were seen with scattered islands of embryonal small round cells. Some of these islands were densely populated with the round cells, while in others there were only a few of this type scattered in the dense fibrous tissue and other areas in which the dense fibrous tissue was without evidence of round or epithelial cells.

Discussion. Although the first patient died in six months and the second in thirty months following nephrectomy, the microscopical studies show very definite tissue changes in the tumors which was undoubtedly due to the irradiation. In Case I the radiologist thought that the patient had received insufficient irradiation. The preoperative treatment should have included the lungs and lymphatic region. In discussing Case II, the radiologist thought that it represented one that had been over irradiated. The patient became anemic and subsequently developed an infection in the lungs and did not show the normal response to this infection. The autopsy findings in this patient were negative for any evidence of tumor or metastatic lesions.

These observations by the radiologist are very helpful for future therapy guidance.

The microscopical findings in the irradiated tumors show changes in the malignant structures that were similar in both tumors. The prevailing structures were fibrosis and necrosis, with varying sized islands of fairly well differentiated epithelial cells. There were scattered here and there in the fibrous tissue small round cells which did not appear to be unlike the large collections of radiosensitive types seen in the nonirradiated mixed tumors. They illustrate the types which Ewing calls cellular inherent resistance. The excessive predominance of fibrous tissue and necrosis and the unusually few scattered areas containing small round embryonal cells indicate that irradiation had caused necrosis and fibrosis displacement of the majority of radiosensitive cells.

The highly vascular areas commonly seen in the embryonal islands were not evident after irradiation. There is definite evidence in the larger vessels of obliterating endarteritis, while the smaller vessels have complete fibrous changes. The fibrosis and necrosis in these tumors were so extensive that the changes could not be definitely attributed to vascular thickening and anemia of the tumor alone nor to direct action of the rays upon the cells. It is my impression that the irradiation changes in these tumors were the result of direct action upon the cells and an indirect action causing anemia, due to necrotic and fibrous changes in the vessels. When sections made from the nonirradiated and the irradiated tumors were stained for fat, the necrotic cells had an excessive amount of fat in the irradiated tumors.

The epithelial cells in the treated tumors showed very little evidence of change. There was no evidence of hyperchromatosis of the nucleus or breaking of the nuclear membrane. The cells were fairly well formed and appeared healthy. They retained the tendency seen in the nonirradiated tumors to differentiate and form imperfect tubules and acini.

In general, the irradiation of the mixed tumors of the kidney had a definite destructive effect upon the embryonal connective tissue cells but little or no effect upon the better differentiated epithelial cells. These observations are in keeping with the laws governing radiosensitivity. These studies illustrate that the clinical effect in reducing the size of mixed tumors of the kidney is directly proportional to the amount of embryonal connective tissue and not the epithelial cells. A tumor of this type with an excessive predominance of epithelial cells will be affected very little by irradiation.

In view of the foregoing observations, it is very evident that irradiation of renal neoplasms does not cause a cure, regardless of the degree of clinical improvement. Procrastination after effective irradiation may lead to disaster. Roentgen therapy usually results in some degree of tumor size reduction which will facilitate operative procedure. It may temporarily check the growth but the malignant character remains. The tumor should be removed surgically after complete irradiation, as soon as safety warrants. This period should be between the sixth and twelfth weeks.

CONCLUSIONS

1. The pathological findings indicate that all kidney tumors should have ample roentgen therapy before surgical removal. This irradiation should include the entire body.

2. Mixed tumors of the kidney are the most radiosensitive.

3. The sarcoma cells in mixed tumors of the kidney are the radiosensitive tissues.

4. The epithelial cells in mixed tumors of the kidney are apparently radioresistant.

5. The reduction in the size of kidney tumors following irradiation appears to be dependent upon the amount of embryonal tissue present.

6. Irradiation of kidney tumors does not destroy all malignant cells even though the effect causes great reduction in size.

7. Surgical procrastination following ir-

radiation results in early recurrence and metastasis.

8. The best results in the treatment of renal neoplasms are dependent upon the clinician, radiologist and pathologist combining their observations.

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A SMALL PLATINUM NEEDLE DESIGNED FOR THE USE OF VARIOUS STRENGTHS OF RADIUM ELEMENT INTERSTITIALLY*

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THE efforts of the American Society for the Control of Cancer and the American College of Surgeons have resulted in the formation of many new tumor clinics, either as departments of general hospitals or as individual institutions. Very few of these new clinics possess funds sufficient to purchase a supply of radium for an emanation plant or to buy radon from the commercial organizations which supply it. It may not be feasible for a clinic to rely on shipments of radon from a distant metropolis. As a consequence, in planning the organization and equipment of a tumor clinic the choice between radium element and radon is of considerable importance, and in a clinic with a limited endowment it is a primary consideration.

In the special cancer hospitals, where large amounts of radium are available, most of the radium is placed in solution and a small portion of the element is used in various applicators, usually plaques and needles. In smaller institutions only the element can be used in fixed containers. Until recently radium element has been utilized for interstitial treatments in needles in which the element is sealed. As a rule, this results in the applicator being used for only the interstitial irradiation of malignant neoplasms. The element which has been sealed in needles has not, as a rule, been available for use in plaques or capsules. The companies which supply radium to institutions and individuals until recently have furnished it only in these specified applicators. It is necessary in smaller tumor clinics to have the entire radium supply as mobile as possible.

THE SMALL RADIUM ELEMENT PLATINUM CELL

At the Tumor Clinic established by the Nassau County Cancer Committee at Farmingdale, Long Island, the radium was purchased in platinum cells of two strengths, containing approximately 3.33 mg. of radium, and 1.33 mg. of radium, respectively. The containers of the radium element in these two strengths were first employed in this country by Dr. George T. Pack at the Tumor Clinic of the Paterson General Hospital and have been in use there for almost three years, and for fifteen months in our own clinic. The cells are of uniform size and filter and one of their decided advantages is their adaptability for use in the various applicators. They may be used in sheath needles employing from one to six cells, depending on the size of the lesion to be treated. There is a decided safety factor in using these removable cells in sheath needles compared with those needles in which radium is sealed, for if a needle in the latter case is broken, there is a loss of radium which is a complication both clinically and economically.

These cells are platinum, 11.5 mm. in length, with an external diameter of 1 mm. and a wall thickness of 0.2 mm. (Fig. 1). These units are then available for use in sheath needles of the standard variety, plaques, moulages, and for grouping in platinum capsules.

SHEATH NEEDLES

The single cell sheath needle with removable platinum-iridium point which has been used in the past had a length of 24.5

* Read at the Nineteenth Annual Meeting, American Radium Society, Cleveland, Ohio, June 11–12, 1934.

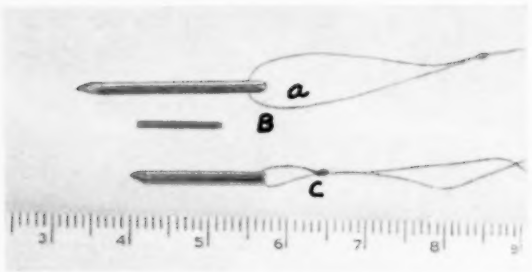

Fig. 1. *a*. Old type sheath needle. *b*. Size of radium element cell. *c*. The small platinum needle.

mm., an external diameter of 1.9 mm. and a wall thickness of 0.4 mm. (Fig. 1). This needle was therefore designed with a length of 24.5 mm. to hold a cell which was only 11.5 mm. in length. It became apparent that the standard sheath needle was entirely too large to use conveniently in small lesions of the lip, tongue or skin. These lesions are treated by radon implants in the larger clinics. It was our hope that some type of needle could be devised in which the element contained in the cell just described could be included and yet have the needle small enough to introduce with a minimum of trauma and obtain uniform distribution of sources of radiation throughout the lesion.

THE SMALL PLATINUM ELEMENT NEEDLE

The cooperation of the Radium Chemical Company and the American Platinum Works resulted in the development of this new needle which is the basis of this report. Platinum with 20 per cent iridium is used. The over-all length of the needle is 17 mm. The internal diameter is 1.05 mm. and the wall thickness 0.3 mm. The diameter of the needle, therefore, is 1.65 mm., allowing 0.05 mm. for clearance of the cell. These needles have been designed with a single eyelet 0.75 mm. in diameter, and an open bore is left in the eyelet end of 0.4 mm. through which a wire may be inserted in case the cell sticks in the barrel of the needle. It was the inclusion of the bore in the eyelet end of the needle that decreased the internal diameter of the needle to 1.05 mm., allowing 0.05 mm. for clearance, and the external diameter of the needle to 1.65 mm. The tip is furnished with a removable trocar point, 2 mm. in length, for the insertion of the cell into the needle. The thread of the point is 1.5 mm. in length. This allows a space of 12 mm. in the bore of the needle for inserting the element cell. The total filtration of needle and cell is 0.5 mm. of platinum (Fig. 2).

CADE NEEDLES

In 1931 C. L. Martin[1] reported the use of small radium needles as a substitute for a radon implant. He utilized the Cade needles of two lengths, one 27 mm. long and the other 11 mm. The larger one contained 1.33 mg. and the shorter one 0.6 mg. Martin's calculation of dosage was based on the theory that 0.6 mg. of radium caused the complete disappearance of a cubic centimeter of squamous cell carcinoma, if the applicator was left in the center of the mass of tissue for seven days (100.8 mg-hr.). From this it is apparent that his smaller needle containing only 0.6 mg. of radium might be too small for lesions of moderate size and the larger needle too bulky. With tumors of moder-

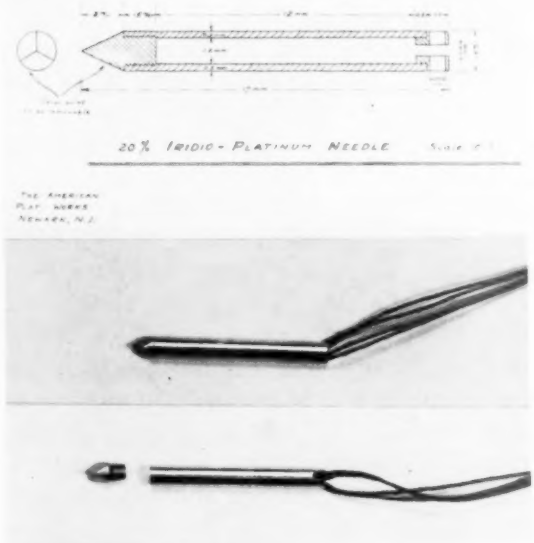

Fig. 2. Scale drawing of the iridio-platinum needle. This was the original scale drawing. The changes in measurements resulted from the inclusion of the bore at the eyelet end.

ate size the smaller cells would also have to be placed in the adjoining normal tissues. With the needle under report spacing is not so difficult as with gold radon implants or the small element needles. However, it is a good plan to space these needles about a centimeter apart when they are placed in position. In lesions of the cheek and tongue it has been necessary to fasten each needle in the tissues with a suture so that movement cannot displace it. In cancers of the lip and skin the transfixion suture is unnecessary.

THE TECHNIQUE OF INTRODUCTION OF THE PLATINUM ELEMENT NEEDLES

These procedures are carried out under the usual surgical asepsis, and with local or block anesthesia. For the introduction of these needles in the skin or lip a fine pointed scalpel is used to make a puncture wound which facilitates the insertion, but the trocar point is sufficiently sharp to insure easy insertion into the cheek or tongue without resort to the puncture. The instruments which were developed for the introduction of the gold sheath needles have been found adequate for use with these small platinum needles. The eyelet of the needle is threaded with heavy waxed dental floss which will insure removing the needle with safety and prevent loss of the applicator while in use. Fine *dermal* sutures are also threaded through the eyelet, and after introduction the tissue is transfixed with a small curved surgical needle and the radium needle held in place by the transfixion suture of dermal (Fig. 3). The waxed dental floss is strapped to the side of the patient's cheek or on the skin near the lesion which is being treated. We have found no difficulty in keeping these needles in place in the tongue, lip, mucosa of the cheek or skin. We have not used them in the posterior portion of the tongue or epiglottis.

DISCUSSION

In our hands this type of interstitial irradiation has seemed as effective as radon implants. Few clinics are able today to avail themselves of radon. Certainly smaller institutions far from the larger supplies of radium and commercial establishments to furnish radon cannot hope to treat their patients with gold tubes. It is hoped, therefore, that this needle may be used as a substitute. But, in the special cancer hospitals in which large quantities of radium are available, little use is made of element needles.

Fig. 3. Small platinum needle assembled for use, including the dermal transfixion suture threaded on a small curved cutting surgical needle.

The dose, filtration and time of application being the same, there is no proved nor demonstrable biophysical difference in the effects of radium element or radon, but there is a uniform intensity of radiation when the element is used. Regaud[7] states there is no beta radiation when 0.5 mm. of platinum is used. There is absolute equality in the radium content of the cells which permits uniform intensity during the interstitial irradiation. There is constancy of irradiation, and, finally, prolonged irradiation can be effected without the addition of implants or the recharging of tubes.

GROUPING

We feel that in the treatment of carcinoma of the lip and tongue the use of

removable platinum needles is more advantageous than radon seeds. This is due to the use of an adequate filter and the uniformity of distribution of irradiation. It is more difficult to distribute radon seeds uniformly throughout a tumor mass. The uneven groupings of seeds occurs even in the hands of the most experienced operators, and if this ensues, areas of necrosis develop in the foci which are over-irradiated. When element needles are removed, no foreign bodies are left in situ. The effect of these foreign bodies is probably exaggerated, but certainly their absence is a point in favor of the use of element needles. The introduction of these needles causes no more pain than the trocar needles for the introduction of radon implants. The patients who have these needles inserted into the tongue or cheek are able to take soft and liquid food with little difficulty, and only in rare instances require medication for pain after the first day.

DOSAGE

According to Quimby and Stewart,[6] a gold seed, if it is to deliver 7 erythema doses to a mass of tissue 1 cm. in diameter, must contain 1.4 mc. (186.2 mc-hr.). This is equivalent in our dosage to 190 mg-hr. The variation in these two dosages is due to the difference in the filter, between 0.3 mm. of gold and 0.5 mm. of platinum. We have proposed to calculate our dosages upon the information which Martin, Quimby and Pack[2] formulated in their calculations for tissue dosage. Their method of calculating dosage requires that the volume of a lesion shall be considered as that of a sphere which will just contain it. In the case of flat or elongated lesions, the volume may be considered that of two or more overlapping spheres. Obviously there may be a considerable difference in the calculated dose, depending on the method chosen. If a tumor mass is almost spherical, it may readily be considered as such. However, in a growth such as a carcinoma of the lip, in which a sphere including the longest diameter would be a much greater bulk of tissue than the actual lesion, it is much more nearly accurate to consider two contiguous smaller spheres, which will actually approximate the tumor in volume. Consideration of a specific case will emphasize this. According to the table of Martin, Quimby and Pack, 20 mc. of emanation, or 2,660 mc-hr., is required to deliver 10 skin erythema doses to a tumor whose diameter is 3 cm., and we require 2,750 mg-hr. However, with our dosage we have not seen necrosis in comparison with the necrosis observed in a corresponding dose of radon. Many of these reactions have been quite severe, especially in lesions 3 cm. or more in diameter. We have usually given 10 S.E.D. in interstitial irradiation with element needles. If a lesion 3 cm. in diameter is given 10 S.E.D. with gold seeds, 20 mc. will be required (2,660 mc-hr.). With the platinum element needles, under report, a lesion of the same diameter will require 2,750 mg-hr. Both of these dosages produce quite severe reactions. But if the lesion is treated as two spheres of 1.5 cm. each, 5 mc. (or a total of 10 mc.) will be required if gold seeds are used. If the element needles are used 680 mg-hr. of interstitial irradiation will be required for a tumor 1.5 cm. in diameter, and under these conditions a tumor 3 cm. in diameter will require 1,390 mg-hr. instead of 2,750 mg-hr., a reduction of 50 per cent in dosage, thereby giving the tumor adequate irradiation with less gamma radiation at a distance where it is not necessary. This is especially important where the tumor approximates bone.

When a part of the element needle is placed in the normal tissue outside the tumor, there are no ill effects and no sloughing occurs. Besides, the dose is concentrated just beyond the growing edge of the tumor where it is most needed, and the total area irradiated is much larger. The volume of the tumor is measured 0.5 cm. beyond the edge of the lesion.

In translating tissue dosage from the employment of millicuries and erythema doses for tumors of various diameters to

TABLE I

Skin erythema doses	Diameter of Mass											
	1 cm.			1.5 cm.			3 cm.			5 cm.		
	mc-hr.		mg-hr.	mc-hr.		mg-hr.	mc-hr.		mg-hr.	mc-hr.		mg-hr.
	0.3 mm. gold filter		0.5 mm. Pt filter	0.3 mm. gold filter		0.5 mm. Pt filter	0.3 mm. gold filter		0.5 mm. Pt filter	0.3 mm. gold filter		0.5 mm. Pt filter
1	0.2	26.6	27	0.5	66.5	68	2.0	266	275	4	532	550
5	1.0	133.0	135	2.5	332.5	340	10.0	1,330	1,375	20	2,660	2,750
7	1.4	186.2	190	3.5	486.5	480	14.0	1,862	1,925	28	3,724	3,840
10	2.0	266.0	270	5.0	665.0	680	20.0	2,660	2,750	40	5,320	5,480

The dosage table of Martin, Quimby and Pack was developed on the basis of the radon being concentrated within the inner half of the radius of the mass. Quimby, in a paper presented at the 1934 meeting of the American Radium Society[5] states that if the sources are uniformly distributed throughout the mass, an increase in amount of radiation of 25 per cent is necessary to deliver the same dose at the periphery. On that basis, all values for millicuries, millicurie-hours and milligram-hours in this table should be 25 per cent greater.

milligram-hours and erythema doses for tumors of a similar diameter we have been aided by Quimby's[3] report on radium and radon needles. Her results have been obtained from the use of radium needles 7 mm. long exclusive of eye and point, containing 1 mg. of radium and filtered by 0.25 mm. of platinum. Calculations have been made for the difference in the lengths of the needles.

In treating tumors interstitially with radium, in calculating dosage with long radium needles, Quimby[4] has advised spacing the needles distances of 1.5 to 2 cm., for a single series of parallel needles. Most of our interstitial irradiation has been given in a single series of parallel needles, but occasionally two series in parallel planes have been used. In this instance, the needles are never placed farther apart than the distance between the planes, and usually closer spacing has been used. In larger lesions the needles are spaced 0.74 cm. apart. The insertion of the needles has always been planned so that the periphery of the lesion receives heavier irradiation than the interior of the tumor mass. While these needles have been designed to use either a radium element cell of 1.33 or 3.33 mg., we have for the most part used the cell of the higher value. For example, to deliver 10 S.E.D. to a tumor 3 cm. in diameter, six needles have been employed each containing approximately 3.33 mg. of radium. The total milligram-hour dosage for such a lesion is 2,750. This necessitates a time of application of 144 hours. Twenty-four hours after the introduction of the needles edema is apparent, consequent upon the trauma of introduction. This usually reaches its maximum at the end of three days, and by the fifth day there is a definite erythema and beginning surface reaction. After the needles are removed, the reaction is moderately progressive and reaches its height about the fifteenth day. From that time on the regression in size of the lesion is noticeable, and by the end of the fifth week the reaction has almost completely disappeared.

CASE REPORTS

The methods of application, dosage and the initial results in the use of the small, platinum radium element needles are illustrated by the following case reports:

CASE 1 (No. 395). V. W., male, aged sixty, was first observed on April 3, 1934. He gave a history of the presence of a tumor on the lower lip of six weeks' duration.

Examination of the lower lip revealed an ulcerated, infiltrating lesion 3 cm. in diameter.

Fig. 4. Case I. Squamous carcinoma, Grade I, lower lip, showing small platinum needles inserted.

A small soft lymph node palpated in each submaxillary triangle was considered to be inflammatory.

The pathological diagnosis was "squamous carcinoma, Grade I."

On April 11, 1934, under local anesthesia, six of the platinum element needles, each containing 3.24 mg. were inserted into the lesion (Fig. 4). These were removed on April 15, the time of application being 113 hours and 10 minutes. The total dosage was 2,200 mg-hr.

A relatively severe radiation reaction had subsided by April 29. The nodes which were palpated at the initial examination had disappeared. The unretouched photograph (Fig. 5) made on June 6 shows the initial result.

Fig. 6. Case II. Squamous carcinoma of the tongue, Grade I, showing insertion of small platinum needles, held in place by dermal transfixion sutures. Total dose 2,484 mg-hr.

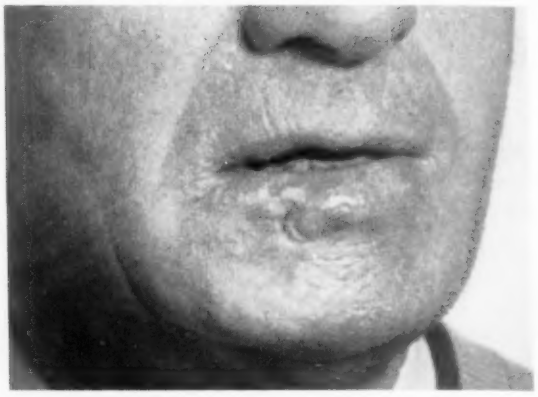

Fig. 5. Case I. Initial result following treatment; 2,200 mg-hr.

Case II (No. 418). J. D., white male, aged fifty-seven, applied to the clinic on April 19, 1934, complaining of a tumor of the tip of his tongue. He stated that it had been present for only three weeks, but from the extent of the lesion and a supplementary history given by a friend, it was ascertained that the history began six months prior to his admission to the clinic.

On examination, the tip of the tongue showed a fungating tumor mass 3 cm. in diameter, which involved the entire tip of the tongue. Two cervical nodes were felt, one on each side of the neck. Their soft consistence gave the impression of an inflammatory and not a metastatic process. The Wassermann reaction was four plus.

The biopsy report was "squamous carcinoma, Grade I."

From April 21 to May 2 the patient received high voltage roentgen therapy to each side of

Fig. 7. Case II. Initial regression in condition five weeks after treatment.

the neck and chin, 1,500 r total dosage to each side being given in daily doses of 300 r each.

On May 2, under local anesthesia, six platinum filtered element needles of radium (3.24 mg. each) were inserted into the tumor for a total of 2,484 mg-hr. These were held in position by dermal transfixion sutures (Fig. 6).

On June 6 most of the irritation of the mucosa had cleared up and there had been total clinical regression of the lesion. There was slight fixation of the tongue (Fig. 7). The patient continues to receive antiluetic treatment.

Case III (No. 430). F. V., a white male, aged fifty-nine, first applied to the clinic on April 27, 1934. A tumor on the right side of his lower lip had been present for one year. It had received no treatment.

Examination. This patient had a typical carcinoma of the right lower lip measuring 1×2 cm., the longer diameter running transversely across the lip. The lesion had ulcerated. No metastatic nodes could be palpated.

The pathological report on tissue removed for histologic study was "squamous carcinoma, Grade 1."

On May 2 four radium element needles were inserted into the lesion and allowed to remain for 92½ hours (1,200 mg-hr.). This bulk of the tumor on the left side had been satisfactorily irradiated but a small area on the right side had not been cared for. Accordingly, on May 8 two needles were introduced into this area, giving an additional 250 mg-hr. of treatment (Fig. 8).

Fig. 8. Case III. Squamous carcinoma, Grade 1, showing insertion of four small platinum element needles.

Fig. 9. Case III. Initial result following radiation therapy.

The accompanying photograph, made June 6, shows the regression in the lesion and the radiation reaction (Fig. 9).

SUMMARY

A needle is reported for the use of radium element for treating tumors interstitially with a filtration of 0.5 mm. of platinum. It has been devised to utilize the standard element cell, but the radium is not sealed in the needle and is available for use in other forms of applicators.

This needle is designed to replace the large single cell sheath needle with a needle less traumatizing and of a size which will accommodate the standard element cell.

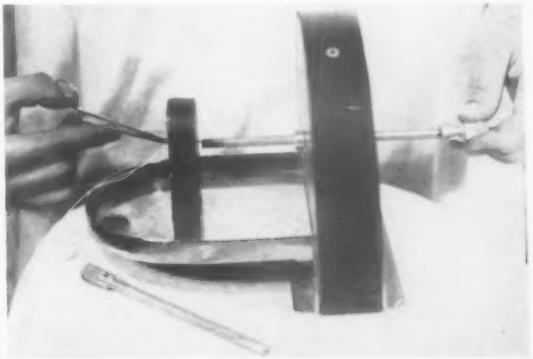

Fig. 10. Lead shielded device which has been developed for attaching and removing the trocar points. Note the fixed point remover on the heavier lead shield. The small lead shield is adjustable and is held in the pan which will catch the trocar point or element cell if it is dropped.

A device has been designed to facilitate the attachment and removal of the trocar points. Adequate protection is provided by two heavy lead blocks. The heavier stationary shield has a point remover which may be rotated. The smaller one may be adjusted at will, in a metal pan, attached to the thicker lead plate. The pan guards against the loss of the trocar point or radium cell, in case either is dropped during the preparation of the needles (Fig. 10).

A method of dosage is reported and a table provided by which milligram-hours and millicurie-hours may be compared. Tissue dosages by these means are calculated.

This needle is not suggested as a substitute for radon, but has been developed for use in clinics where radon is not available but whose members are qualified to use radium. It has not been designed to promote the use of radium indiscriminately.

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EDITORIALS

PROGNOSIS IN RENAL TUMORS

THE kidney is the seat of the greatest variety of new growths of any organ in the body and this probably to a certain extent accounts for the poor prognosis that is given in renal growths. Benign growths other than pelvic papillomata form less than 7 per cent of those affecting the kidney and are usually found accidentally during operation or at autopsy. This fact alone accounts for the high mortality rate in renal tumors. Malignant growths of the kidney are subdivided into those arising in the substance of the kidney and those having their origin in the renal pelvis, the former being by far the most frequent. Kidney tumors have further been subdivided into two groups: the congenital tumor that occurs in infancy or childhood, the renal embryoma, and the tumors that occur in adult life, the carcinomata and hypernephromata. The renal embryoma is usually encountered before the third year of life. It is a highly malignant, infiltrating type of tumor and metastasizes early. It usually manifests itself by increasing abdominal distention associated with ascites or by malaise, constipation and emaciation, and the prognosis is usually grave.

Walker,[1] in a recent article on the prognosis of renal growths, calls attention to the fact that, in a large series of cases under different surgeons, the primary operative mortality ranged from 12 to 40 per cent, averaging about 32 per cent, that the later mortality of children who survived operation was from 80 to 90 per cent, of whom more than 80 per cent succumbed within a year either from local recurrences, metastases or cachexia, and that under the most favorable conditions a cure may be expected in only 5 to 7 per cent of the cases, the prognosis being least favorable in children under two years of age.

While the prognosis of renal growths in children is very bad, that in malignant tumors of the kidney in adult life is little better. Judd and Hand[2] reported in 1929 that not more than 10 per cent of their patients had lived as long as ten years after nephrectomy and that few had survived three. After studying the collected experience of various clinics, Wharton[3] came to the conclusion that failure to cure malignant tumors of the kidney results in the vast majority of instances from the inability of the surgeon to remove the local growth completely due in part to the size of the tumor and to its vascularity. This coupled with the notorious tendency for renal tumors to metastasize makes any form of therapy which would add to the cure or even to the lessening of the mortality rate acceptable. Postoperative roentgen treatment of renal tumors has been carried out in a number of clinics but unfortunately has influenced the mortality statistics very little.

Some hope of improvement in the present statistics as regards the cure of renal tumors is found in the work of Waters[4] who reported at the Twenty-fifth Annual Meeting of the American Roentgen Ray Society in Pittsburgh his results in the preoperative irradiation of cortical renal tumors. Too much time and effort have been expended on the classification of renal tumors as regards their embryonal or cortical or renal types. Waters classifies the tumors as to their radiosensitiveness, which for practical pur-

[1] Walker, Kenneth. Prognosis of renal growths. *Lancet*, March 9, 1935, *1*, 565–566.

[2] Judd and Hand. Quoted by Wharton.

[3] Wharton, L. R. Preoperative irradiation of massive tumors of the kidney. *Arch. Surg.*, Jan., 1935, *30*, 35–51.

[4] Waters, C. A. Preoperative irradiation of cortical renal tumors. Am. J. Roentgenol. & Rad. Therapy, Feb., 1935, *33*, 149–164.

poses is an ideal method. As a result of his experience with preoperative irradiation of cortical renal tumors, he has found that tumors of the hypernephroma type and embryonal carcinomas are radiosensitive, that papillary carcinomas of the renal pelvis and the malignant papillary cyst adenomas are radioresistant. Irradiation as used by him in his group of cases has caused a striking reduction in the size of radiosensitive renal tumors and has rendered tumors which were inoperable on account of their large size operable. Irradiation produces extensive morphological changes in sensitive tumors. These changes are characterized by alterations in the cellular structure, extensive fibrosis, hyalinization and necrosis. Contrary to what has been reported from experimental studies, the normal renal tissue has apparently not been injured by irradiation in the dosages employed in his cases.

Waters calls attention to the fact that reduction in the size of the radiosensitive tumors begins almost immediately after the institution of irradiation and continues for a period of several weeks after the cessation of treatment. This reduction in size gives a favorable prognosis, but it is imperative that operative removal of the kidney should be carried out within a few weeks after either the first or second series of treatments, depending on the degree of shrinkage of the tumor as revealed by palpation and retrograde pyelographic studies. Waters emphasizes this point because he says a regrowth of the tumor may occur if operation is delayed too long and that the oft repeated statement that preoperative irradiation increases the difficulties of operation has not proved true in his cases. If the mortality rate in renal tumors is to be lessened, earlier diagnosis must be made, and Waters again calls attention to the importance of hematuria and pain as a symptom and sign in renal tumors and he states that the best method of diagnosis in their cases has been retrograde pyelography. By this method they have been able to differentiate pelvic cortical tumors in 80 to 100 per cent of the cases and in the series of cases treated 93.4 per cent of all these tumors have been radiosensitive.

Elsewhere in this issue there is an article by Bothe on the effect of roentgen therapy on tumors of the kidney. His experience closely parallels that of Waters and the splendid work of these two authors calls attention forcibly to a new approach to the treatment of renal tumors, a chapter in medicine which is sadly in need of revision.

ELIS BERVEN

THE current issue of *Acta radiologica* carries this happy note on its title page: "This volume contributed by the present staff of the Radiumhemmet is dedicated to Elis Berven—the Chief of the Radiumhemmet—on the occasion of his fiftieth birthday as a token of deep appreciation of the devotion with which he has served the institution and in acknowledgment of his achievements in the field of radiotherapy."

This will be of great interest to the many friends of Dr. Berven in this country and the AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY takes this occasion to join with his European friends in felicitating him on his fiftieth birthday.

FRANKLIN H. MARTIN
M.D., C.M.G., D.P.H., LL.D., D.SC., D.S.M., F.A.C.S.
1857-1935

THE death of Dr. Franklin H. Martin on March 7, 1935, at the age of seventy-seven, has deprived medical science of an outstanding leader and radiology of a valuable friend. The gap left by the passing of this great surgeon, patriot and public benefactor will be less pronounced because his works will continue as a living memorial for generations to come. It had been his lot to enjoy a rich measure of success in his life-long efforts to organize and advance surgery and its branches, and to achieve a

better understanding between physicians and the lay public. Not to many men has it been given to see the generous fruition of so many years of exceptionally well-planned effort to elevate the standards of medical practice and to educate the public to appreciate the difference between good and mediocre medical service.

Born in Ixonia, Wisconsin, Dr. Martin was educated in the public schools and academies of Wisconisn and obtained his medical degree from Northwestern University Medical School, Chicago, in 1880. In 1886 he was married to Isabelle Hollister, a daughter of John Hollister, one of the founders of Northwestern University Medical School.

Dr. Martin's organizational work began early. With the collaboration of Dr. W. F. Coleman, in 1888 he organized the Chicago Post-Graduate Hospital School. As his specialty, he chose gynecology and served as Professor of Gynecology in the Policlinic of Chicago, and later in the Post-Graduate Hospital School, the Woman's Hospital, and in the Charity Free Hospital of 30 beds which he organized in 1887.

In 1905 Dr. Martin founded *Surgery, Gynecology and Obstetrics*, one of the leading surgical journals of the world, adding to it in 1913 the *International Abstract of Surgery*. In 1910 he initiated the annual conferences of the Clinical Congress of Surgeons of North America, which later came to be known as the Clinical Congress of the American College of Surgeons. This College, organized by Dr. Martin in 1913, now has a membership of 11,500 of the outstanding surgeons and surgical specialists of the Western Hemisphere.

During the Great War, Dr. Martin contributed notably to the work of the American medical profession. He was the medical member of the Advisory Commission of the Council of National Defense appointed by President Woodrow Wilson in October, 1916, in which capacity he served throughout the war. He was Chairman of the General Medical Board of the Council of National Defense and also of the Executive Committee of the General Medical Board from 1917 to 1919. Under this Board there were organized State and County Committees of Medical men enrolling 32,000 medical officers and 5,000 dentists in the Reserve Corps, and 72,000 in the Volunteer Medical Service Corps. During the war he held the rank of colonel and spent three months of his service with the American Expeditionary Forces.

Many rewards came to this distinguished physician. In addition to his M.D., received in 1880, he was a Fellow of the American College of Surgeons. He was decorated by King George V of Great Britain through H. R. H. the Prince of Wales in Washington, D. C., on November 13, 1919 (Companion of the Order of St. Michael and St. George), in recognition of services rendered to the British Empire during the Great War. The United States Government awarded the Distinguished Service Medal. He was also made a Commander of the Crown of Italy, an honor conferred in recognition of his influence in founding Loyola Base Hospital at Vicenza during the war, serving the fourth and sixth armies on the Italian front. Other degrees included Honorary LL.D. from Queen's University, Belfast, Ireland, from the University of Wales, Cardiff, and from the University of Pittsburgh; D.P.H., Detroit College of Medicine and Surgery; and D. Sc. from Northwestern University, which institution he served for many years as a member of the Board of Trustees.

In his literary work Dr. Martin was prolific. In addition to a large number of books and monographs on the subject of gynecology, including a Treatise on Gynecology, published in 1903, Dr. Martin has left us the following books: South America, from the Surgeon's Point of View, published in 1923; Australia and New Zealand, published in 1924; The Joy of Living, an Autobiography, published in 1933; Fifty Years of Medicine and Surgery, an Autobiographical Sketch, published in 1934; Digest of the Proceedings of the Council of National Defense During the World War,

1934. The Joy of Living is an inspiring story of a purposeful life, as well as a valuable historical document.

Other honors which came to Dr. Martin were the presidency of the International Association of Gynecologists and Obstetricians in 1919, and of the American Gynecological Society in 1919. Honorary membership was conferred upon him in many domestic and foreign medical societies, too numerous for listing in these pages.

One of the most important labors of the late Dr. Martin, and most far-reaching in its influence, was the foundation and directing guidance of the American College of Surgeons and its yearly Clinical Congress. Somewhat tardily but nevertheless definitely in recent years the influence of Dr. Martin has been attracted to help in establishing recognition on a high professional plane of the work of the radiological members of the American Medical Association. Officially, we mourn the loss of this staunch figure and influence in American medicine. Those of us who had the privilege of personal acquaintance of this genial personality mourn the loss of an affectionate friend.

James T. Case

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. E. P. Pendergrass, University Hospital, Philadelphia, Pa. Annual Meeting: Atlantic City, N. J., Sept. 24–27, 1935.

American College of Radiology
Secretary, Dr. B. H. Orndoff, 2561 N. Clark Street, Chicago, Ill. Annual meeting: Atlantic City, N.J., 1935.

Section on Radiology, American Medical Association
Secretary, Dr. J. T. Murphy, 421 Michigan St., Toledo, Ohio. Annual meeting: Atlantic City, N.J., June 10–14, 1935.

Radiological Society of North America
Secretary, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N.Y. Annual meeting: Detroit, Mich., Dec. 2–6, 1935.

Radiological Section, Baltimore Medical Society
Secretary, Dr. W. B. Firor, 1100 N. Charles St., Baltimore. Meets third Tuesday each month, September to May.

Radiological Section, Los Angeles County Medical Society
Secretary, E. N. Liljedahl, Los Angeles, Calif. Meets on the fourth Wednesday of each month at the California Hospital.

Radiological Section, Southern Medical Association
Secretary, Dr. H. J. Walton, 104 W. Madison St., Baltimore, Md. Annual meeting, St. Louis, Mo., Nov. 19–22, 1935.

Brooklyn Roentgen Ray Society
Secretary, Dr. A. L. Voltz, 115 Myrtle Ave., Richmond Hill, N.Y. Meets monthly on first Tuesday, October to April.

Buffalo Radiological Society
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St., Buffalo, N.Y. Meets second Monday of each month except during summer months, place of meeting selected by the host.

Chicago Roentgen Society
Secretary, Dr. R. G. Willy, 1138 N. Leavitt. Meets second Thursday of each month October to May inclusive at the Palmer House.

Cincinnati Radiological Society
Secretary, Dr. H. G. Reineke, General Hospital, Cincinnati, Ohio. Meets third Monday of each month, October to May, inclusive.

Cleveland Radiological Society
Secretary, Dr. Otto Glasser, Cleveland Clinic. Meetings are held at 6:30 P.M. at the Cleveland Chamber of Commerce Club rooms on the fourth Monday of each month from October to April, inclusive.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. E. R. Witwer, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne Country Medical Society Building.

Florida Radiological Society
Secretary, Dr. F. J. Payton, Miami Beach, Florida. Meetings held twice a year, May and November.

Illinois Radiological Society
Secretary, Dr. H. W. Grote, 219 N. Main St., Bloomington, Ill. Regular meetings held quarterly.

Indiana Roentgen Society
Secretary, Dr. J. N. Collins, Indianapolis, Ind. Annual meeting each February 22 in Indianapolis.

Michigan Association of Roentgenologists
Secretary, Dr. S. W. Donaldson, St. Joseph's Mercy Hospital, Ann Arbor, Mich. Three meetings a year, Fall, Winter, and Spring.

Milwaukee Roentgen Ray Society
Secretary, Dr. S. A. Morton, Columbia Hospital, Milwaukee, Wis. Meets monthly. Place of meeting designed by the president.

Minnesota Radiological Society
Secretary, Dr. L. G. Rigler, University Hospital, Minneapolis, Minn.

New England Roentgen Ray Society
Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston, Mass. Meets monthly on third Friday, Boston Medical Library.

Radiological Society of New Jersey
Secretary, Dr. P. S. Avery, New Brunswick, N. J. Meets annually at time and place of State Medical Society. Mid-year meetings at place designated by the president.

New York Roentgen Society
Secretary, Dr. E. F. Merrill, 30 W. 59th St., New York. Meets monthly on third Monday, New York Academy of Medicine, at 8:00 P.M.

North Carolina Roentgen Ray Society
Secretary, Dr. Major Fleming, Rocky Mount, N. C. Annual meeting at time and place of State Medical Society. Mid-year scientific meeting at place designated.

Central New York Roentgen Ray Society
Secretary, Dr. C. F. Potter, 820 S. Crouse Ave., Syracuse, N.Y. Three meetings a year—January, May, and November.

Pacific Roentgen Club
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association

Pennsylvania Radiological Society
Secretary, Dr. L. E. Wurster, Williamsport, Pa. Annual meeting, Schenley Hotel, Pittsburgh, Pa., May 17–18, 1935.

Philadelphia Roentgen Ray Society
Secretary, Dr. Thomas Loughery, Germantown Hospital. Meeting first Thursday of each month from October to May inclusive, at 8:15 P.M., in Thompson Hall, College of Physicians, 19 S. 22d St.

Rochester Roentgen Ray Society, Rochester, N.Y.
Secretary, Dr. W. W. Fray, Strong Memorial Hospital. Meets monthly on second Thursday from October to May, inclusive, at 7:45 at the Rochester Medical Association Building.

St. Louis Roentgen Ray Society
Secretary, Dr. P. C. Schnoebelen, Missouri Bldg., St. Louis, Mo. Meets first week of each month. Time and place of meetings designated by president.

South Carolina X-Ray Society
Secretary, Dr. R. B. Taft, 105 Rutledge Ave., Charleston. Meets at time and place of South Carolina State Medical Association.

Tennessee Radiological Society
Secretary, Dr. F. B. Bogart, 311 Medical Arts Bldg.

* Secretaries of Societies not here listed are requested to send the necessary information to the Editor.

Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary-Treasurer, Dr. J. H. Smith, Lubbock, Texas.
Meets annually one day preceding the meeting of the Texas State Medical Association.

University of Michigan Department of Roentgenology Staff Meeting
Secretary, Dr C. B. Peirce, University Hospital, Ann Arbor, Mich.
Meets each Monday evening from September to June, at 7 p.m. at University Hospital.

University of Wisconsin Roentgen Club
Secretary, Dr. E. A. Pohle, 1300 University Ave , Madison, Wis.
Meets monthly on last Thursday, October to April, Service Memorial Institute, at 4:30 p.m.

Virginia Roentgen Ray Club
Secretary, Dr. V. W. Archer, University Hospital, University, Va.
Meets annually in October.

Cuba

Sociedad Cubana de Radiologia y Fisioterapia
Secretary, Dr. Francisco Padron, Enrique, Villuendas 64, Havana, Cuba. Meets monthly in Havana.

British Empire

British Institute of Radiology Incorporated with the Röntgen Society
Meets on the third Thursday of each month, from November to June inclusive, at 8:15 p.m., at 32 Welbeck St., London, W. 1, or as advertised.

Electro-Therapeutic Section of the Royal Society of Medicine (Confined to Medical Members)
Meets on the third Friday of each month during the winter at 8:30 p.m. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

Section of Radiology and Medical Electricity, Australasian Medical Congress
Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

Radiological Section of the Victorian Branch of the British Medical Association
Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

Section on Radiology, Canadian Medical Association
Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

Radiological Section, New Zealand British Medical Association
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch. Meets annually.

Continental Europe

Belgian Society of Roentgenology
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

Société de Radiologie Médicale de France
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

Société Suisse de Radiologie (Schweizerische Röntgen-Gesellschaft)
Secretary for French language, Dr. A. Grosjean, La Chaux de Fonds.
Secretary for German language, Dr. Scheurer, Molzgasse, Biel.
Meets annually in different cities.

Société Francaise d'Electrothérapie et de Radiologie Médicale.
Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

Association of German Roentgenologists and Radiologists in Czecho-Slovakia
Secretary, Dr. Walter Altschul, German University, Prague, 11.52.

Deutsche Röntgen-Gesellschaft (Gesellschaft für Röntgenkunde und Strahlenforschung)
Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

Süd- und Westdeutsche Röntgengesellschaft
Meets annually in different cities.

Nord- und Ostdeutsche Röntgengesellschaft
Meets annually in different cities.

Dutch Society of Electrology and Roentgenology
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

Societa Italiana Radiologia Medica
Secretary, Professor M. Ponzio, University of Turin, Turin.

Societatea Romana de Radiologie si Electrologie
Secretary, Dr. Nicolae Busila, 44 Elizabeta Blvd., Bucarest.
Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson.
Meets annually.

Leningrad Roentgen Ray Society
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly, first Monday at 8 o'clock State Institute of Roentgenology and Radiology, Leningrad.

Moscow Roentgen Ray Society
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

Polish Society of Radiology
Secretary, Dr. Jan. Kochanowski, 45 Gornoslazka St., Warsaw. Meets annually.

Warsaw Section, Polish Society of Radiology
Secretary, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summertime.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with exception of the Denmark Society, meets every second month except in the summertime.

Society of Medical Radiology in Sweden
Meets in Stockholm.

Society of Medical Radiology in Norway
Meets in Oslo.

Society of Medical Radiology in Denmark
Secretary, Dr. G. Biering, Copenhagen.
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

Society of Medical Radiology in Finland
Meets in Helsingfors.

Vienna Roentgen Society
Meets first Wednesday of each month, at 6.30 p.m. at Zentral-Röntgen Institut des allgemeinen Krankenhauses, Alserstrasse 4.

Orient

Japan X-Ray Association
c/o Orthopedic Surgery, Tokyo Imperial University.
Meets annually in April.

Kinki Roentgen-Abend Society
Director, Dr. Prof. Taiga Saito, Ogawaoike Tyoto, Japan. Meets bi-monthly on third Sunday.

POST-GRADUATE CONGRESS

The Tomarkin Foundation is organizing under the auspices of the University of Brussels, its Seventh International Medical Post-Graduate Congress officially approved by the General Comissariat of the Government for the World Exhibition.

This Congress, dealing with "Diagnostic and Therapeutic Actualities" will be held during the World Exhibition from September 12 to 19, 1935, in the Faculty of Medicine of the University of Brussels and from September 20 to October 2 at Spa.

More than one hundred professors from nearly forty-five universities will lecture on the following special topics: Affections of the Cardiovascular System; Diseases of the Blood; Cancer; Tropical Diseases; Infectious Diseases; Free Lecture and Social Medicine.

For particulars apply to the Secretary, Tomarkin Foundation, Faculté de Médecine, 97 rue aux Laines, Bruxelles, Belgium.

INVITATION TO MEMBERSHIP

The following notice should be of great interest to readers of the Journal:

The American Association of the History of Medicine

You are cordially invited to active membership in this Association which recently completed its tenth successful year of affiliation with the international Association of the History of Medicine.

The American Association holds an annual meeting with afternoon and evening (dinner) sessions and its officers anticipate a future with regional meetings of interested groups in various cities of North America.

Membership, $1.50 annually. Membership with subscription to Medical Life, $2.50. Membership with subscription to either Janus (German) or Aesculape (French) $4.50. Membership with subscription to both foreign journals, $7.50; to all three, $8.50.

The President of the Association is Dr. Edward B. Krumbhaar, University of Pennsylvania, Philadelphia; the Secretary is Dr. E. J. G. Beardsley, 1919 Spruce St., Philadelphia.

The next annual meeting is May 6, 1935, afternoon and evening (dinner) sessions, Haddon Hall, Atlantic City, N. J.

INDIANA ROENTGEN SOCIETY

The Eight Annual Meeting of the Indiana Roentgen Society was held in Indianapolis at the Indianapolis Athletic Club on February 22, 1935. Dr. B. H. Nichols of the Cleveland Clinic, addressed the society, and the following officers were elected: President: Dr. D. C. McClelland, Lafayette; President-Elect: Dr. E. M. Van Buskirk, Fort Wayne; Vice-President: Dr. P. D. Moore, Muncie; Secretary-Treasurer: Dr. J. N. Collins, Indianapolis.

AMERICAN UROLOGICAL ASSOCIATION

The Thirty-second National Convention of the American Urological Association and its Western Branch Society will be held in San Francisco, California, June 24–28, 1935. A splendid program has been arranged and headquarters will be in the Palace Hotel. On Wednesday, June 26, Dr. H. H. Young of Johns Hopkins University will deliver the Ramón Guiteras Lecture on "The Abnormalities and Plastic Surgery on the Genitourinary Tract." Monday, June 24, has been set aside for the annual golf tournament which will take place on picturesque evergreen links overlooking the Pacific Ocean, followed by a stag dinner. A banquet will be held on the evening of June 26 and a dinner dance on June 27. Advantage should be taken of the greatly reduced railroad rates to visit San Francisco, an ideal and interesting place to spend a summer vacation.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers as space permits.

Die klinische Röntgendiagnostik der inneren Erkrankungen. Von Dr. Herbert Assmann, O. Professor und Direktor der medizinischen Klinik an der Universität Königsberg I. Pr. Fifth edition. Teil I and II. Paper. Price, RM 87. Bound, RM 95. Pp. 1248, with 1216 illustrations and 10 plates. Berlin: F. C. W. Vogel, 1934.

Were not Dr. Herbert Assmann's "Roentgen Diagnosis of Internal Diseases" well recognized and highly regarded by the profession it would not now be in its fifth edition. It is a large work—two volumes totaling over 1200 pages fully illustrated, the purchase of which would not be made in these times of economic stress without due consideration. A brief study of the work explains the confidence of the buying public. Here is a very complete treatise on diagnosis of internal conditions by the roentgen ray which is valuable as a text as well as an atlas and which presents normal and pathologic phases of the subject in a most logical manner. Both illustrations and context are the product of much care and thought based on wide experience.

The internist can find here a complete study of his roentgen problems. The specialist in cardiology finds about 200 pages devoted exclusively to his particular field and numerous paragraphs and illustrations elsewhere relating the blood vascular system to diseases of other organs. Diagrams, tracings, and film reproductions at all possible angles combine with tables of physical characteristics and explanatory texts to give both the novice and connoisseur a complete source of diagnostic material. The other intrathoracic structures are treated in a similar manner, consuming the remainder of the 500 pages of Volume I.

Four hundred pages of Volume II are devoted to the abdominal organs. Gastrointestinal diagnosis is covered in detail with emphasis placed on mucosal studies according to the newer methods of Berg, Åkerlund, et al., and with frequent reference to the foundation work of Forssell, Groedel and others. Special methods of studying the liver, spleen, pancreas, adrenals, peritoneum and abdomen generally, including pneumoperitoneum and thorotrast, receive concise mention. But few pages are devoted to the urinary tract, this being apparently recognized as belonging more especially to the field of the urologist than to the internist. The last 200 pages of the second volume deal with the central nervous system and with the bones and joints so far as their structure and function is related to diseases of the endocrine glands or other problems of the internist. Bone changes are not grouped as to morphology and structure but rather as to the underlying etiologic factor.

Throughout the text, the author evinces a marvelous knowledge of the literature, giving full credit to each investigator and including voluminous bibliographies. The books are carefully edited, well printed and constitute a truly great value as an addition to an internist's or roentgenologist's library.

E. Walter Hall

A Roentgenological Study of Acute and Chronic Otitis Media. By Gösta Runström, Med. Lic. (*Acta radiol.*, Suppl. XVII.) Paper. Price, 20 Swed. cr. Pp. 90, with illustrations in the text and numerous separate plates. Stockholm: Acta radiologica, 1933.

From the title of this work one might expect the subject matter to be limited to the middle ear, but the author includes under this heading acute and chronic mastoiditis.

Anatomical principles and variations in technique as applied to the production and interpretation of roentgenograms occupy the greater part of the text. Apparatus, dark room handling, stereoscopy and various positions are considered. The author prefers stereoscopic films and uses both primary and secondary screening, i.e., with cone and with lead grids. He recommends a grid of the Lysholm type to avoid unnecessary distance of the part from the film and consequent loss of detail. The reproductions of his roentgenograms testify as to the excellent films he obtains.

Examination of the films should include both ortho- and pseudo-stereoscopy, the author explaining that additional information is obtained by the use of both methods. In his own work the

author uses four projections. They are: (1) lateral, 15 degrees; (2) axial ortho-projection in lateral position; (3) frontal ortho-projection in lateral position; (4) axial mento-vertical projection.

The clinical material consists of 47 cases carefully selected from a group of over 1,000 examinations. They are carefully described as to provisional diagnosis, history, course, physical examination, roentgen findings (in detail), operative findings, microscopic report and final outcome of the case. One hundred and six roentgenograms are reproduced as negatives on good paper so that excellent detail is preserved.

The book contains much useful and exact information and is worthy of careful study.

E. Walter Hall

Reliefstudien an der normalen und krankhaft veränderten Speiseröhre. (*Acta radiol.*, Suppl. xviii.) Von Richard Schatzki, S. Zt. Leiter des Röntgeninstitutes der medizinischen Universitätsklinik, Leipzig. Paper. Price, 20 Swed. cr. Pp. 149, with 159 illustrations. Stockholm: Alb. Bonniers Boktryckeri, 1933.

It is the opinion of the reviewer that few roentgen studies are so poorly done as the routine examination of the esophagus. Many of the men of long experience whose other work is certainly above the average dismiss the esophagus as normal with but a passing glance. Dr. Schatzki's book should therefore be well received as it not only stimulates interest in the esophagus but serves as a guide in the improvement of technique and diagnosis. It is difficult to see how anyone could view the beautiful relief roentgenograms with which this book is profusely illustrated without a desire to reproduce them in his own practice.

The monograph includes but a brief review of anatomy. Methods of relief study are carefully explained and are well worth while as shown by the character of his results. The normal characteristics of the mucosa as well as the influence of respiration, atropine and pilocarpine are considered. The author agrees with Cannon and Moser as to the influence of respiration on the caliber and prominence of the folds, contradicting the findings of other investigators.

In addition to the usual conditions, namely, inflammations, neoplasms and diverticula, the author describes a condition of the mucosa to which his clinic gives the name "Kräuselung" (crinkling). This has appeared in the literature but not as a separate entity or with adequate description. Esophageal varices are studied in a very interesting manner as to their cause, location, roentgen appearance and effect on the lumen of the esophagus and the elasticity of the wall.

All roentgenologists should have a work of this type in their library.

E. Walter Hall

L'année électro-radiologique. By Morel-Kahn, in collaboration with G. Bonte, A. Devois, G. Duclaux, T. Fainsilber, H. Fischgold, J. Guilhem, R. Humbert, P. Marques, W. Strouzer, L. Stuhl. Paper. Price, 40 fr. Pp. 232, with 27 illustrations. Paris: Masson et Cie, 1934.

In this year book Morel-Kahn and his collaborators have collected and summarized what they regard as the most important papers in radiology, with the intention of bringing to the attention of the specialist the important papers in his field, some of which he may have missed because of the special journal in which the paper appeared, and also with the idea of bringing to the attention of the general man the importance that radiologic procedures may have in both the diagnosis and treatment of his patients.

The subject matter is divided into four parts: The first, roentgen diagnosis, takes up pages 11 to 107; the second, general radiotherapy, pages 113 to 162; the third part, electrology, pages 171 to 214; the fourth and concluding section, pages 217 to 229, the important meetings of radiologic societies. There is a final index of the contents. At the end of each section there is a short bibliography of the works cited. Insofar as this book will give the busy specialist or clinician a rapid and quite complete summary of what is going on in radiology it is a welcome addition to the literature. It is hoped that later editions of this year book will be more comprehensive and perhaps a little more critical than this, the first of the series.

E. T. Leddy

Wege zur Verhütung der Entstehung und Ausbreitung der Krebskrankheit. By Prof. Dr. Bernh. Fischer-Wasels, Direktor des senckenbergerischen pathologischen Instituts der Universität Frankfurt a.M. Pa-

per. Price, RM 2.70. Pp. 75. Berlin: Julius Springer, 1934.

The author begins this book with a review of the modern theories of the causes of cancer and among them general factors, constitutional disposition, external factors, the rôle of alkalosis, intoxication of the body by tar, arsenic and indol are discussed in some detail. He advocates strengthening the resistance of the body to cancer by decreasing its alkalosis as far as possible and based on this idea he suggests a program of prophylaxis and treatment of cancer. Among the things suggested to diminish bodily alkalosis is the inhalation of carbon dioxide, but here the author admits its ineffectiveness once a tumor has been established in man. It should therefore be used by those in the cancer age as a precautionary measure. Alkalosis may also be decreased by some dietary measures the author recommends. Infections and irritations are to be avoided. It is advisable to stimulate the recticulo-endothelial system. He condemns the marriage of those with a definite familial malignant background. Since it is admitted by the author himself that many of his ideas are theoretical or have not been tested out in man the value of the book as a practical aid in the treatment of cancer is minimal. However, it is a valuable contribution not only because it gives a good review of the theories of the causes of cancer but also because it suggests methods, yet to be worked out, which may prove of value in the prevention and treatment of malignant disease.

E. T. Leddy

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DEPARTMENT OF TECHNIQUE

Department Editor: ROBERT B. TAFT, M.D., M.S., 105 Rutledge Ave., Charleston, S. C.

AN IMPROVED STEREOSCOPIC EXAMINATION OF THE MASTOID PROCESS EMPLOYING THE POTTER-BUCKY DIAPHRAGM

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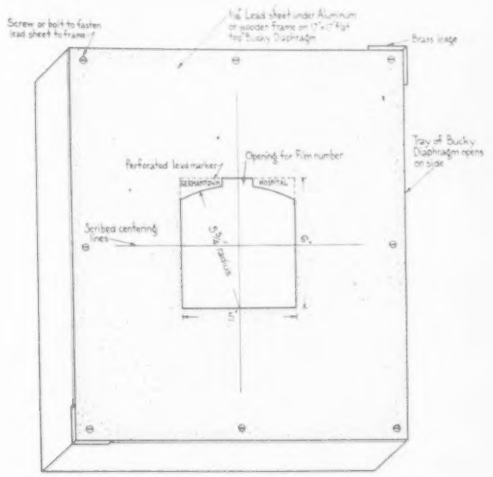
IN A previous article* there was outlined, in detail, the manifold advantages of a stereoscopic roentgenographic examination of the mastoid process, in which method only one film is used for the entire procedure, either one 8″×10″ or 10″×12″ film. Since many roentgenologists prefer the mastoid examination to be made upon the Potter-Bucky diaphragm, the original device was slightly modified in order to be adaptable for this purpose. The principle of obtaining stereoscopic views of both the right and left mastoid processes upon the one film remains the same.

The illustrations are practically self-explanatory, and in addition the technique involved is graphically depicted beneath each illustration of the device.

As shown in Figure 1, a 17″×17″ flat-top Potter-Bucky diaphragm is employed with the device mounted upon it, which of course is readily removable. One 10″×12″ cassette is used, and as is illustrated in the accompanying schematic drawings beneath the illustration of the device, it is successively shifted after each roentgenographic exposure, and this is also described in the following summary.

Summary of Technique. 1. Place the identification number with right lead marker in the indentation provided for it. Place head in position for roentgen exposure of right mastoid process, in the opening for this purpose. Immobilize the head of patient by means of band. Insert cassette in tray of diaphragm in the lower left hand corner as shown in (1). Tilt cone and position stereo-shift for first roentgenogram of right mastoid process.

2. Remove cassette. After inverting, reinsert cassette into lower left hand corner, as shown in (2). Tilt cone and position stereo-shift for second roentgenogram of right mastoid process.



Stereoscopic Mastoid Device For Bucky Diaphragm Technic

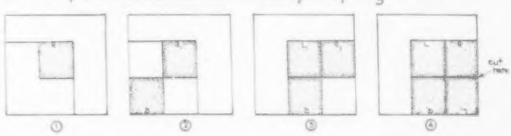


FIG. 1. Note graphic depiction of method of successively shifting cassette after each roentgenographic exposure. This technique employs one 10″×12″ cassette when employing a 17″×17″ flat-top Potter-Bucky diaphragm.

3. Replace the left lead marker for the right. Place head in position for roentgen

* Loughery, T. P., and Stecher, W. R. An improved stereoscopic mastoid examination. AM. J. ROENTGENOL. & RAD. THERAPY, 1933, *29*, 112–115.

exposure of left mastoid process. Immobilize head of patient. Shift cassette to the lower right hand corner of tray as shown in (3). Leave the tilt of cone and position of stereo-shift as in 2. Focus over left mastoid process and take first roentgenogram of left mastoid process.

4. Remove the cassette. After inverting, reinsert cassette into the lower right hand corner of tray as shown in (4). Tilt cone in opposite direction and position stereo-shift as it was in 1. Take second roentgenogram of left mastoid process.

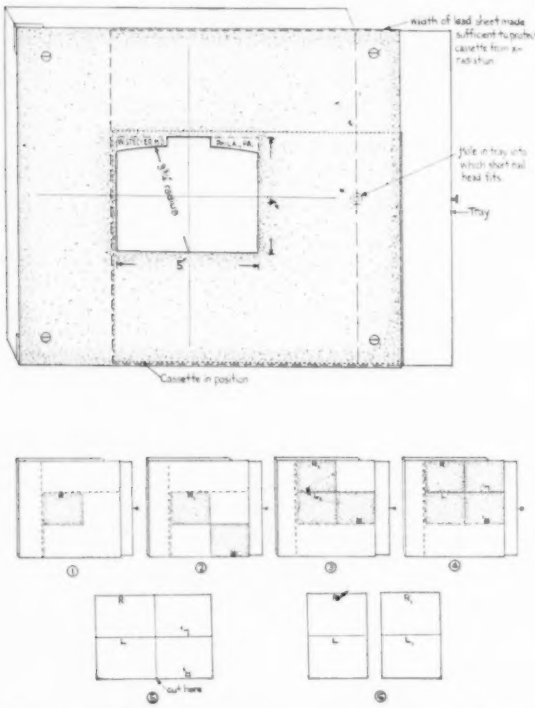

width of lead sheet made sufficient to protect cassette from x-radiation
Hole in tray into which short nail head fits
Tray
5"
Cassette in position
cut here

Fig. 2. This shows one 8″×10″ cassette, utilized in the technique when using a 14″×14″ flat top Potter-Bucky diaphragm. Schematic drawings (1), (2), (3), (4) illustrate the method of shifting the cassette for the four required exposures, (5) and (6) being the finished film and the manner in which it is cut for placement in the stereoscopic viewing boxes.

When the film is developed and dry, it is cut in half, as shown in (4) each resultant film measuring 6″×10″. The films are viewed in the stereoscopic boxes, with 10″ as the base, when the mastoids have been roentgenographed with the stereo-shift transversely (see Fig. 3).

In Figure 2, a 14″×14″ flat-top Potter-Bucky diaphragm is utilized and the device is mounted upon it as is illustrated. In this procedure, one 8″×10″ cassette is used, and, as shown schematically below the apparatus, it is successively shifted after each exposure, as is described in detail below.

Summary of Technique. The procedure is identical with the preceding description, with the following notable exceptions.

1. The short nail-head is placed in the small opening in the tray provided for it, as shown in the illustration. This permits of exact positioning of the tray when inserted. The cassette is placed in the lower left hand corner of the tray as shown in (1).

2. Cassette is removed, inverted and reinserted in lower left hand corner of tray as shown in (2).

3. Cassette is shifted to upper left hand corner of tray as is shown in (3).

4. Cassette is removed, inverted and reinserted in upper left hand corner of tray as shown in (4).

When the film is developed and dry it is cut in half, as shown in (5) and each resultant film is 8″×5″ as shown in (6). The base for viewing in the stereoscopic boxes is 5″, when the stereo-shift is transverse.

The following physical factors are employed:

With Potter-Bucky Diaphragm, with Screens

Time	Dist.	Ma.	Kv.P.
4 sec.*	25″	10	88
2 sec.*	30″	30	88

* = variable factor.

A 3″×7″ cone should be used.

The procedure is readily adaptable to any region of the body where bilateral stereoscopic views are desired, such as, mandible, nasal accessory sinuses, etc. Thus, in the routine four-view sinus technique, the method can be utilized to great advantage, when using a 10″×12″ cassette, there being sufficient film space for each view if properly positioned. The technique employed is given in the following tabular form (page 560):

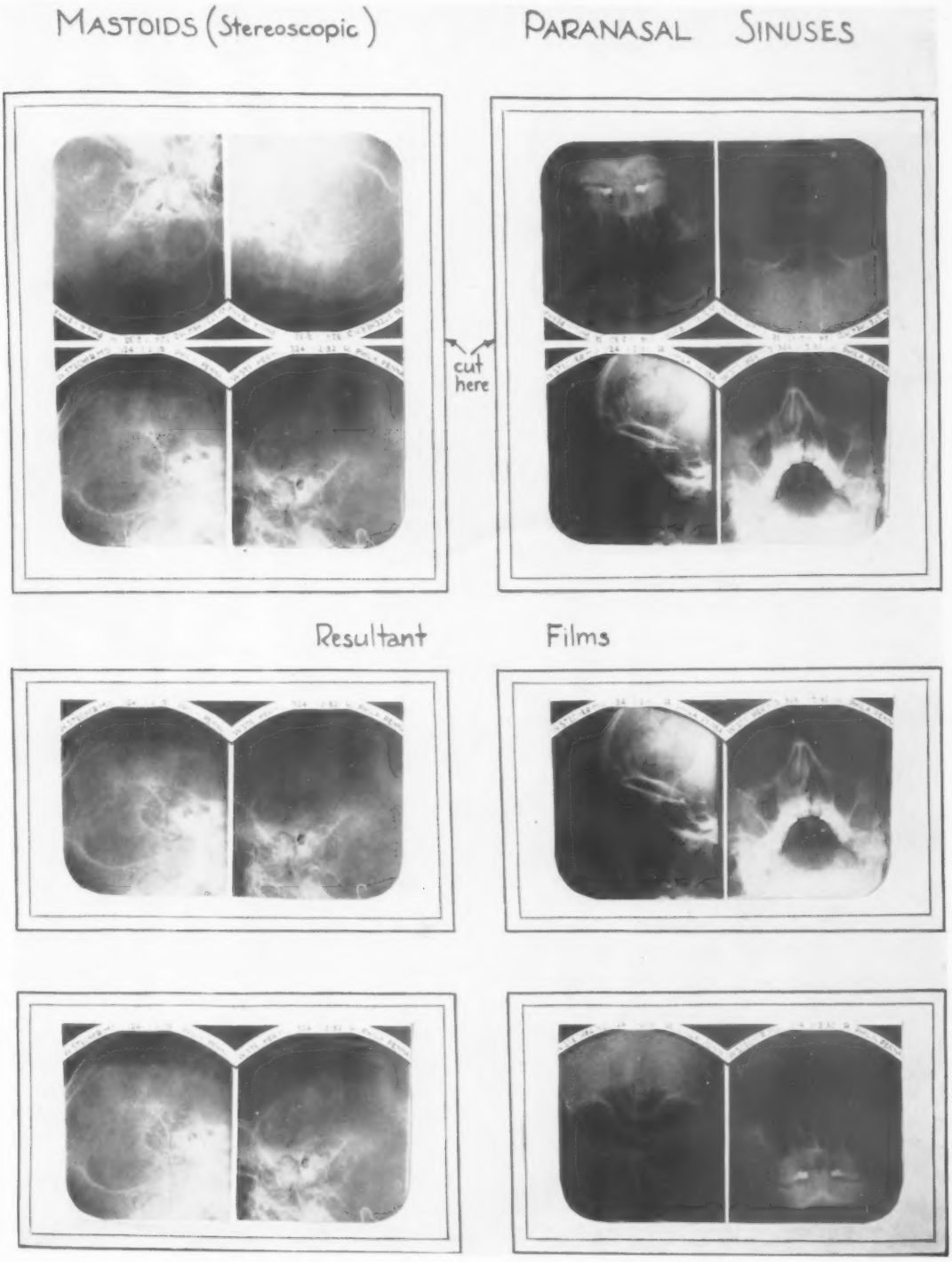


Fig. 3. Illustrating the finished films and their final appearance after being cut in half.

With Potter-Bucky Diaphragm	Time	Dist.	Ma.	Kv.P.
1. Nose-chin position. Centered at junction of nose and upper lip. No tube tilt.	8 sec.*	25″	10	88
2. Nose-forehead position. Centered at bridge of nose. Tilt tube 12° toward feet.	5 sec.	30″	30	72*
3. Open mouth-sphenoid position. Centered at open mouth. Tilt tube 24° toward feet.	6 sec.*	25″	10	88
	5 sec.	30″	30	69*
4. Head, true lateral position. Centered at bridge of nose. No tube tilt.	3 sec.*	25″	10	88
	2 sec.	30″	30	63*

A 3″×7″ cone is employed. * = variable factor.

Many variations of the four-view sinus technique can be improvised by the roentgenologist. As an example: one set of stereoscopic views of the sinuses in the Caldwell position; two other posteroanterior views of the sinuses on the same film; an additional separate 8″×10″ film of the lateral view made at a 6 foot distance comprising the examination. It must be noted that the stereo-shift in sinus roentgenography is necessarily in the long axis of the body, and therefore this fact must be taken into account in placing the finished cut films in the stereoscopic viewing boxes.

If the roentgenologist does not possess a portable Potter-Bucky diaphragm, he can use the Potter-Bucky diaphragm beneath the roentgenographic table. The grid is fastened at one end of the table and the outline of the tray together with centering lines and the central aperture are scribed upon the table top. The device is modified to adequately cover the designated area, and the technique as has been outlined for the 17″×17″ grid is followed (see Fig. 3).

However, when roentgenographing the paranasal accessory sinuses, non-stereoscopic, the cassette is not inverted, but merely positioned in the four respective positions, thereby obtaining the four different exposures upon the one roentgenogram, in the same plane, which permits of viewing the various projections upon the one film, without cutting the film. The sheet lead is mounted upon sheet metal upon a wooden frame, which rests upon the tray of the grid diaphragm. By manually moving the cassette beneath the device with central rectangular aperture, the respective views are successively obtained.

The following enumerations briefly summarize the inherent advantages of this method:

1. One cassette and therefore one standard intensifying screen is employed for all four exposures. Thereby, all undesirable differences in contrast and density attributable to variations in age and speed of screens is eliminated.

2. In employing merely one film, there is a saving of a considerable percentage of the total cost of the examination.

3. The examination is speeded up, inasmuch as it is unnecessary to carry the cassettes back and forth from the control room to the roentgenographic table.

4. The former inconvenience of viewing many wet films prior to discharging the patient has been eliminated, as with this method one film is rapidly scanned. This indirectly prevents many scratched films.

5. The finished film is cut in half as has been described, and the respective halves are placed in the viewing boxes in perfect position, allowing the simultaneous examination of both right and left mastoid processes.

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ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

GENITOURINARY SYSTEM

HUTTER, KARL. Über die Röntgendiagnose der Nierentuberkulose nebst Bemerkungen über den Anwendungsbereich der instrumentellen und intravenösen Urographie. (The roentgen diagnosis of renal tuberculosis with some considerations of the application of instrumental and intravenous urography.) *Fortschr. a. d. geb. d. Röntgenstrahlen*, Jan., 1933, *47*, 20–42.

In renal tuberculosis a roentgen examination without a contrast medium in the kidney usually shows no characteristic changes. Roentgen study is the most valuable in those cases where the cystoscopic or cultural studies give the least information. In cases with a typical cystoscopic picture and tubercle bacilli in the urine intravenous urography serves to confirm the diagnosis. In these cases instrumental pyelography is contraindicated by the risk of spreading the infection. The author gives a tabular view of the indications and contraindications for each method of examination. Even though roentgen examination alone may make the diagnosis in certain early cases the author feels that it is safer to supplement it with a complete clinical study. The author describes some valuable signs—toxic atony of the upper urinary tract and the so-called psoas-border symptom of the ureter and some of the changes in the lumen of the ureter which may lead one to suspect the presence of renal tuberculosis.—*E. T. Leddy.*

TEPOSU, E., and DANICICO, I. Tuberculoza renală; considerațiuni generale și statistice în legătură cu 70 cazuri de tuberculoză renală operate în Clinica chirurgicală din Cluj, în ultimii 10 ani. (Renal tuberculosis; general and statistical considerations in connection with 70 cases of renal tuberculosis operated upon at the Surgical Clinic of Cluj in the last ten years.) *Cluj. med.*, 1933, *14*, 195–210; 280–296.

This is a lengthy article dealing with all phases of the pathology, diagnosis and treatment of renal tuberculosis on the basis of a study of 70 cases, the reports of several of which are briefly included.

Concerning the value of roentgen diagnosis, the following statements are made: Roentgen diagnosis acquires a more and more important rôle in the diagnosis of renal tuberculosis. The simple film occasionally helps to demonstrate an enlarged or a diminished renal shadow or the presence of calculous deposits or finally it may aid in association with other laboratory methods in the establishment of operative indications. Ascending pyelography, which is next in chronologic order, especially when associated with ureteropyeloscopy, furnishes additional information, the various images being of five main types: (1) in the parenchymatous (nodular and granular) renal tuberculosis in which the lesions have not as yet communicated with the calyces or kidney pelvis the pyelographic image appears normal; (2) in the open caliculo-papillary and pyelo-papillary primitive form a deformity of the calyces or of part of the kidney pelvis is noted, the more typical forms being those of the fragmented, cornucopia or of the motheaten appearance or, in case of more extensive involvement, of the verticalization of the kidney pelvis; (3) in the open caseous ulcerous secondary form, when the cavities communicate with the calyces or pelvis, the images are characterized by circular shadows situated within the parenchyma proper or communicating with the kidney pelvis which also may appear deformed; (4) in case of very advanced destruction and especially in the so-called tuberculous pyelonephrosis the image of the pelvis assumes the appearance of a pouch, the calyces being entirely missing, and (5) in mastic kidney the image is that of a baseball bat, a term used by the authors for the first time. Ureteropyeloscopy gives information concerning the motility, a fact which is very important, especially in the early phases of tuberculosis. In the period of involvement of the mucosa alone a functional atonia is observed which changes to organic atonia as soon as the musculosa becomes also invaded. The first picture is very similar to that of hydronephrosis whereas the second gives rise to the "verticalized pelvis or band-like ureter" characterized by rigidity.

Intravenous pyelography which is the most recent of all methods of roentgen exploration constitutes a valuable adjunct since it permits the recognition of tuberculosis in cases which sometimes cannot be diagnosed by the former procedures. In this respect the possibility of estimating the secretoric capacity of the diseased kidney is of special aid. It must be mentioned, however, that the intensity of the images in intravenous urography is to a great extent a result of the functional or anatomical state of the excreting paths, especially of the pelvis and ureter. The stasis (functional in the beginning and organic later) often makes up for the secretoric deficit of the kidney so that the urographic images appear equally opaque or even more so than the normal parts. Of the various forms of lesions observed, the most important are the image of the fragmented cornucopia of the calyces, the verticalized pelvis and the band-like ureter. In case that the tuberculosis is open and the cavitary images situated in plain parenchyma intravenous pyelography gives images which equal those obtained by ascending pyelography. A further advantage of intravenous pyelography is that it permits a good view of the entire kidney and that thus the modifications of volume and structure are estimated more precisely than in the ascending method. Finally the possibility of comparing the image with the opposite side gives definite indications concerning the localization of the foci of the disease and of the total function of the kidney. It should be borne in mind, however, that in the early cases an entirely normal roentgen image may appear also with intravenous pyelography.—*T. Leucutia.*

Harrah, Frank W. Primary carcinoma of the ureter. *Am. J. Surg.*, Dec., 1934, *26*, 550–560.

The diagnosis is fully discussed. The pyeloureterogram will show the exact size and location of the tumor and the conditions in the ureter and kidney above which have arisen as its sequelae. Two main types of filling defects are observed: (1) a brush-like shadow produced by penetration of the contrast fluid into the folds and interstices of a papillary tumor, and (2) a helmet-shaped defect, when the structure of the tumor is solid. A tumor projecting into the lumen will be seen most clearly when it proceeds from the lateral wall. With infiltrative growths an indistinctness of the ureteral wall rather than a filling defect will be observed. However, the roentgen findings are rarely sufficiently positive to assure the diagnosis. The 2 cases reported bring the total number of recorded cases to around 70.—*W. R. Brooksher.*

Ballenger, Edgar G., Elder, Omar F., and McDonald, Harold P. Rupture of the bladder. *South. M. J.*, Aug., 1934, *27*, 713–715.

Intravenous urography is safer than former methods of diagnosis in rupture of the bladder, which, while at times facilitating the diagnosis, often seemed to increase the mortality rate. The newer procedure involves little delay and furnishes information of associated pelvic fractures by the same procedure. Roentgenograms of satisfactory diagnostic quality are readily obtained except when there is a lowering of the blood pressure from shock or hemorrhage which so hinders the output of the dye (skiodan used by the authors) that the method is not applicable. In these cases it is recommended that retrograde cystograms be made using the dye for contrast medium.—*W. R. Brooksher.*

Butler, W. W. S., Jr., and Peterson, C. H. Roentgen ray aids in prostatic resection. *Virginia M. Monthly*, 1934, *61*, 276–280.

Air cystograms and urethrograms are desirable as a means of examination in prostatic disease. The cystogram is sufficiently accurate for a reliable opinion prior to cystoscopic study and operation, while the urethrogram permits a study of the condition of the post-resection urethra without discomfort to the patient. The technique is described and illustrative roentgenograms are presented.—*W. R. Brooksher.*

Castronovo, E., and Baroni, B. Fenomeni idromeccanici nella pielografia ascendente. (Hydromechanical phenomena in ascending pyelography.) *Arch. di radiol.*, 1933, *9*, 742–743.

The authors report the results of a series of experimental studies of hydromechanical phenomena seen in ascending pyelography. The experiments were made on dogs, the ureters being exteriorized and various substances injected into the pelves under pressures of from 40 to 200 mm. mercury. The substances used were lithium iodide, simple uroselectan, uroselectan B, abrodil, perabrodil, pyelofanin and toriofanin.

From an examination of many pyelograms they come to the conclusion that in the dog pyelotubular, pyelo-tubulo-interstitial or lymphatic and sometimes pyelovenous reflexes can be brought about by varying the pressure used in injecting the substances. Pyelotubular reflexes can be produced with low pressures and leaving the liquid in the pelves two hours or more; these pictures were produced most readily with lithium iodide followed in sequence by pyelofanin, uroselectan and abrodil. Pictures of pyelo-interstitial reflex were obtained with these substances and with uroselectan B under pressures of 60 to 80 mm. mercury; they were less clear with perabrodil and did not appear at all with toriofanin.

Pyelograms with pyelovenous reflux mixed with pyelo-tubulo-interstitial reflex with subcapsular detachment were obtained with the various substances using pressures of from 80 to 220 mm. mercury. With perabrodil and uroselectan B the pictures of pyelovenous reflux were less confused than with the other substances. With toriofanin the pictures were very distinct and not accompanied by pyelo-interstitial or lymphatic reflux.

The authors conclude that when contrast media are injected at pressures equal to or lower than that of kidney secretion the pictures depend on the physicochemical composition of the contrast media. These may be subject to pyelorenal processes of osmosis, diffusion, capillarity and diapedesis. Toriofanin does not seem to be subject to these processes and uroselectan B and perabrodil are less subject to them than the other contrast media.—*Audrey G. Morgan.*

Baroni, Benigno. Sopra un caso di calcolosi renale dimostrata dalla pielografia ascendente. (A case of kidney stone demonstrated by ascending pyelography.) *Arch. di radiol.*, 1933, *9*, 734–738.

A case is described in a man of forty-five who had signs of kidney stone. Neither ordinary roentgenography nor descending pyelography showed any stone. Ascending pyelography, however, with the injection of 4 c.c. toriofanin under considerable pressure showed a large calculus filling the whole of the left kidney pelvis. Operation verified the finding. The stone was made up of 85 per cent uric acid, 8 per cent calcium oxalate and 7 per cent phosphates.

Sometimes in stones of the kidney pelvis neither direct roentgenoscopy nor ascending pyelography gives clear enough pictures for diagnosis and in such cases ascending pyelography under considerable pressure with liquids which give marked contrast is of decisive value. Such examinations should not be made until some days after descending pyelography, as the liquids used for the ascending examination and those used for the descending examination may produce precipitates which interfere with the clearness of the pyelogram.—*Audrey G. Morgan.*

Baroni, Benigno. Meccanismo e curva di eliminazione dei mezzi di contrasto per la pielografia discendente. (Mechanism and curve of elimination of the contrast media used in descending pyelography.) *Arch. di radiol.*, 1933, *9*, 739–741.

Experiments, the technique of which is described, were performed on guinea pigs and rabbits to determine the mechanism of elimination of the different media used for descending pyelography. It was found that elimination takes place for the most part through the glomeruli. There was no signs of elimination or absorption in the convoluted tubules of the 1st or 2d order. Elimination did not take place uniformly throughout the kidney but at different places at a distance from each other and differing in different animals.

Uroselectan B and perabrodil were eliminated more quickly than simple uroselectan. They caused a more marked water diuresis than other substances. As these substances require a considerable amount of water for their elimination, experiments were made to see whether their elimination could be hastened by furnishing more water to the organism by means of hypodermoclysis, by mobilizing the water of the tissues with mercurial diuretics, giving drugs with an action on the heart and kidneys such as scilla or on the kidneys, such as diuretin. Elimination was found to be hastened by hypodermoclysis and diuretin but not by the other substances.—*Audrey G. Morgan.*

SKELETAL SYSTEM

Joachim, Henry, and Wasch, Milton G. Fragilitas ossium in five generations. *Ann. Int. Med.*, Jan., 1934, *7*, 853–860.

The authors have observed 8 cases of fragilitas ossium in a family covering three generations and have treated the disease in five gener-

ations. Case reports with roentgenograms of 3 of the cases are presented. Some of the cases had multiple fractures while others had a ligamentous relaxation. The thinning of the shafts of the metatarsals and metacarpals producing relative enlargement of the head and base is especially mentioned as an accompaniment. Blue sclerae were present in all cases. Blood calcium studies were not conclusive.—*W. R. Brooksher.*

Perrot, Ad., and Babaiantz, L. Quelques considérations sur le syndrome de Klippel-Feil (Les hommes sans cou). (Some considerations on the Klippel-Feil syndrome (man without a neck).) *J. de radiol. et d'électrol.*, Dec., 1933, *17*, 670–674.

The Klippel-Feil syndrome was first described in 1912. It is of congenital origin, uncertain etiology, and occasionally hereditary in nature. Clinically it is characterized by the following triad: (*a*) shortness of neck (due to numerical reduction or fusion of the cervical vertebrae); (*b*) low hair line, which is a consequence of the first factor, and (*c*) limitation of the movements of the head. More rarely one encounters other symptoms such as basilar kyphosis, deviations of the vertebral column, obliquity of the axis of the eyes, nystagmus, low position of the ears, disproportion of the length of extremities and trunk, lowering of the mammary areolae, elevation of the shoulder, and occasionally diminution of intelligence. Anatomically the syndrome has likewise three chief characteristics: (*a*) cervicodorsal block vertebrae through fusion of the cervical and of the first dorsal vertebrae; (*b*) open neural arches (spina bifida), and (*c*) elevation of the thoracic cage.

Feil, in 1919, after analyzing 12 personal observations and those collected from the literature, distinguished three types of the syndrome according to the numerical reduction of the vertebrae, extension of the vertebral anomalies and appearance of the clinical signs. Type I, representing the maximum of numerical reduction and a complete fusion of the cervical vertebrae; Type II, the intermediary form, and Type III, the generalized form in which the reduction of the vertebrae is not localized to the cervical region alone but extends to the entire spine, and in which the malformations are very pronounced and coexist with other anomalies (such as hernia, hair lip, etc.).

The authors had the opportunity of observing a case of Klippel-Feil syndrome belonging to Type II and in this article they report the case in detail, using several photographs, roentgenograms and diagrammatic drawings for illustration.—*T. Leucutia.*

Barsony, Theodor, and Frisch, Ernst. Beiträge zur Röntgenologie der "Akrosklerose." (The roentgenology of akrosclerosis.) *Fortschr. a. d. geb. d. Röntgenstrahlen*, 1933, *47*, 287–293.

In this lesion there is resorption of the terminal phalanges which leads to deformity. In florid cases there is at first a loss of tissue but later definition of the boundary of resorption occurs which is defined by compact bone. The stump of the phalanx is widened at the end in a manner suggestive of tuberculosis. As a result the end of the phalanx is small (microphalanx). In mild chronic cases condensation of bone occurs at the distal portion of the terminal phalanx giving a frosted end phalanx (Zuckergussendphalanx). The basal stump of the terminal phalanx also becomes smaller and synostosis with the middle phalangeal head occurs. In such cases there is some resorption of the middle phalanx. With a high degree contraction of the first interphalangeal joint there is resorption of the neighboring parts of the middle and proximal phalanges. These changes are all illustrated by roentgenograms. The authors feel that resorption dessicans, the Zuckergussendphalanx and synostosis of the mutilation stump are pathognomonic of akrosclerosis.—*E. T. Leddy.*

Niedner, Franz. Schaltknochen in den Zwischenwirbelscheiben. (Nodes in the intervertebral discs.) *Fortschr. a. d. geb. d. Röntgenstrahlen*, 1933, *47*, 70–76.

In older people there occur occasionally irregularly distributed calcified areas in the intervertebral discs, usually in the anterior region of the lumbar spine. At autopsy the study of the discs which show these calcified areas often shows tears and gaps as evidence of previous functional stresses. These tears result in necrosis of the intervertebral discs. Calcification of these areas may result in the process of repair. There is almost always marked spondylitis deformans in the spines which show these calcifications. Since both lesions are due to the same causes—tears of the intervertebral discs—these calcifications are usually regarded as typical of spondylitis deformans.—*E. T. Leddy.*

Solotuchin, A. S. Die Blutversorgung der Wirbelsäule des Menschen. (The blood supply of the human spine.) *Fortschr. a. d. geb. d. Röntgenstrahlen*, 1933, *47*, 175–182.

The author presents some interesting anatomical studies which he carried out by roentgenographing the spines of 68 cadavers of babies after injection of opaque media. Some of the normal relationships are illustrated. He points out that on account of the richness of anastomosis between the vessels their anatomy is best demonstrated by stereoroentgenogram. —*E. T. Leddy.*

Rubaschewa, Anastasia. Über den Processus lateralis der Lendenwirbel und spez. über den Processus styloideus (im Röntgenbilde). (The processus lateralis of the lumbar spine with special reference to the processus styloideus as seen roentgenologically.) *Fortschr. a. d. geb. d. Röntgenstrahlen*, 1933, *47*, 183–188.

Many anatomists feel that the lateral or transverse process of the lumbar vertebrae is a rudimentary rib. In confirmation of this view there is a costotransverse foramen at the lower part of the transverse process. The author has studied this rare anomaly in 2 cases. The lateral process has two processes, the processus mamillaris and the processus accessorius. If the length of the processus accessorius is more than 4 mm. it is called the processus styloideus. This process exists in a number of mammals. This process has been observed in 1,000 roentgenograms of the lumbar spine in 34 women and 44 men between the ages of eighteen and fifty-nine (7.8 per cent of the cases). There does not seem to be any relationship between the regressive or progressive characteristics of the lumbosacral region and the existence of the styloid process.—*E. T. Leddy.*

Cohn, Max. Konstitutionelle Hyperspongiosierung des Skeletts mit partiellem Riesenwuchs. (Constitutional hyperspongiosis of the skeleton with partial gigantism.) *Fortschr. a. d. geb. d. Röntgenstrahlen*, 1933, *47*, 293–298.

Cohn reports the case of a man, aged forty-five, who had peculiar expansion of bone at the metaphyses. The cortex was extremely thin and the bones showed hyperspongiosis. These changes occurred not only in the long bones but also in the long bones of the hands and feet with an apparent predilection for the latter. The anomaly always involved the metaphyseal portion of the diaphysis. There were also some irregular changes in the thoracic bones and the vertebrae. The ribs were very transparent and at their vertebral ends were irregularly expanded. There was therefore a marked scoliosis. The middle and posterior parts of the skull were thickened and the sella was small but otherwise normal. Besides these changes there was a general symmetrical enlargement of the hands and feet. There were no definite characteristics of acromegaly. As an explanation for these lesions the author offers some hormonal upset probably associated with an abnormally small pituitary.—*E. T. Leddy.*

Jaeger, W. Beobachtungen über den Achsenverlauf der Wirbelsäule. (Some observations on the direction of the axis of the vertebral column.) *Fortschr. a. d. geb. d. Röntgenstrahlen*, 1933, *47*, 299–312.

The author describes a long distance technique of determining the axis of the spine in standing patients. He says that any recent change such as that due to fracture produces a particular angle in the axis of the spine. The angle of the axis is the most noticeable sign of a rotation dislocation of the cervical spine. As a new sign of fracture of the arch Jaeger describes a displacement of the spinous process and the formation of an axial angle which is open dorsally. This is absent in long-standing cases. An abnormal thickness of a limited portion of the spine as a result of injury of the vertebral body or the intervertebral disc has been demonstrated for the first time in the living subject. As a result of reparative processes and the adaptive changes associated with them the axial angle changes to a small kyphotic angle arc which is characteristic of old changes. Three cases of secondary softening of fractured vertebral bodies are described and their relationship to Kümmell's disease are discussed. In conclusion, the author points out some of the possibilities of error. In every case of vertebral fracture a general teleroentgenologic view of the body with the patient erect, is indicated, for by this method one can reproduce exactly roentgenograms taken in identical cases for comparison.—*E. T. Leddy.*

Roederer. Peut-on distinguer les ostéophytes post-traumatiques des ostéophytes statiques? (Is it possible to differentiate post-traumatic

osteophytes from static osteophytes?) *Bull. et mém. Soc. de radiol. méd. de France*, Oct., 1933, *21*, 643–646.

For a while, as a result of the publications of Léri, all vertebral osteophytes were considered as a pathognomonic manifestation of lumbarthritis. Within a short time, however, a number of authors started to oppose such a standpoint, citing as their chief argument the observations made during the war that traumatic osteophytes often appeared as a result of various inflammatory or mechanical pathological irritations. Moreover, it is common to see osteophytes in most vertebral lesions, as, for example, syphilis, gonococcus infections, gout, cancerous metastases, all instances in which the vertebral articulations were subjected to abnormal motions, arthritis, arthrosis, etc. The question arises whether it is possible to differentiate all these osteophytes from the so-called traumatic osteophytes, a fact which is important from a medicolegal standpoint. In analyzing the problem, the author arrives at the conclusion that especially the following factors are of importance: the form of traumatism and its intensity, the immediate clinical symptomatology, the local and general roentgen findings, the time interval which occurred between the first roentgenogram and trauma, and finally, data of a more general nature as heredity, constitution, habits, and the laboratory findings. All in all, one may say that the post-traumatic manifestations of the vertebral column may be placed in three distinct groups: (1) the lesion itself; (2) the cicatrization of the lesion which extends over a period of a year at least, and (3) osteophytes of static origin which result from adaptation of the spine to the new mechanics and which extend over a period of several years. These latter present no difference from the static osteophytes of other origin.—*T. Leucutia.*

Raviola, Bona. Studio radiologico della rotula in condizioni normale e patologiche. (Roentgen study of the patella under normal and pathological conditions.) *Arch. di radiol.*, 1933, *9*, 751–776.

The author describes the normal anatomy of the patella and the normal roentgen picture of it. He then discusses 74 cases of his own and 16 observed in another hospital of pathological conditions of the patella including bipartite patella, fractures, luxations, primary tuberculosis, propagation to the patella of white swelling of the knee, secondary sarcoma, post-traumatic inflammation of the patella, deforming osteoarthrosis, hemophiliac changes, deformity of the knee and patella from rickets, ankylosis between the femur and patella from progressive tuberculosis, exostoses of the femur and patella, osteomyelitis of the knee with extension to the patella, primary osteomyelitis of the patella, cystic osteodystrophy and osteodystrophy of the familial type and atrophy in tuberculosis of the knee. A number of the cases are illustrated with roentgenograms.—*Audrey G. Morgan.*

Laquerrière. Les os surnuméraires du pied. (Supernumerary bones of the foot.) *J. de radiol. et d'eléctrol.*, Dec., 1933, *17*, 663–669.

The differential criteria of supernumerary bones of the foot from sesamoids are that the latter usually occur in the path of tendons, have a regular form, either rounded or ovoid, and are somewhat flattened on the surface towards the skeleton. The supernumerary bones, on the contrary, are more irregular and appear as a prolongation of bone giving the impression as if they were a piece separated from the bone. They are often observed bilaterally although the type of anomaly may assume a certain variation in shape.

Supernumerary bones of the foot are quite manifold but in practice one may distinguish three or four types which are: (1) The trigone bone. This bone is frequently situated on the posterior aspect of the astragalus. Shepherd, who was first to describe it from the roentgen standpoint, considered it erroneously as a fracture of adolescents. Normally the astragalus has a convex curve posteriorly, there being a very small tuberosity at the juncture with the inferior aspect. This tuberosity not infrequently forms an apophysis and in certain cases it is detached, forming the trigone bone. (2) The external tibial bone. This bone occurs in about 10 per cent of the cases. It appears behind the internal portion of the scaphoid either in the form of an apophysis or as an isolated bone. (3) Peroneal bone. This bone is extremely frequent. It is situated below the cuboid, being of a variable size and form and often appearing divided into several fragments. (4) Vesalian bone. This bone, on the contrary, is very rare. It appears at the posterior aspect of the fifth metatarsal and has a very variable form. Its

knowledge is important since a confusion with acquired deformities is possible. The author, on the basis of 600 films, was able to distinguish three forms of the Vesalian bone: the median, elongated and enlarged form, an association of several being noticed sometimes in the same individual.

The article is illustrated with numerous diagrammatic drawings showing the different types and many variations of the supernumerary bones of the foot.—*T. Leucutia.*

Klaften, E., and Priesel, R. Weitere Untersuchungen über Knochenveränderungen bei Lues congenita. (Some further studies on the bone changes in lues congenita.) *Fortschr. a. d. geb. d. Röntgenstrahlen*, 1933, *47*, 59–69.

This study of 60 cases of congenital syphilis is an elaboration of the study of 37 cases which the authors reported in Volume 42, No. 3, of this journal in which the value of early antiluetic treatment of the mother is emphasized.—*E. T. Leddy.*

Hellner, Hans. Klinische Einteilung und Abgrenzung der Sarkome und Riesenzelltumoren des Knochens. (Clinical classification and peculiarities of bone sarcomas and giant cell tumors.) *Fortschr. a. d. geb. d. Röntgenstrahlen*, Jan., 1933, *47*, 1–20.

The author points out some of the difficulties in classifying bone tumors on a clinical, a roentgenologic or a pathologic basis. He also holds that classification of them as peripheral or central or periosteal or myelogenous also leads to confusion. Giant cell tumors should not be classified with bone sarcomas as they are not true sarcomas since they are usually in all essentials benign lesions. Rarely they may show transitional changes and then behave like a true bone tumor. After these general considerations Hellner discusses the clinical, roentgenologic and pathologic aspects of the several varieties of bone tumors and their differential points taking up giant cell tumor and Ewing's tumor in some detail.—*E. T. Leddy.*

BLOOD AND LYMPH SYSTEM

Moschetta, Giovanni. Rari reperti di calcificazioni polilinfoghiandolari. (Unusual cases of polyglandular calcification.) *Arch. di radiol.*, Aug., 1933, *9*, 682–696.

Two cases are described in which roentgen examination showed calcification of the lymphatic glands of the neck. Both the patients had pulmonary tuberculosis and the relationship between the glands of the neck and those of the thorax is discussed, together with its bearing on the cervico-apical origin of tuberculosis. Cervico-apical tuberculosis is generally mild and shows a tendency to sclerosis while that originating at the hilus is more severe.—*Audrey G. Morgan.*

Walsh, Grossbeck, and Stickley, Courtney, S. Acute leukemia with primary symptoms in the rectum, a rapid increase in the white cells and a fatal outcome. *South. M. & S.*, Dec., 1934, *96*, 648–649.

A fatal case of acute leucemia is reported in which the primary symptom was bleeding from long-standing hemorrhoids. Examination of the rectum showed a mass of prolapsed edematous hemorrhoids, bleeding readily, and with pressure changes. In six weeks the white cell count rose from 8,500 to 207,500.—*W. R. Brooksher.*

ROENTGEN AND RADIUM THERAPY

Baensch, W. Zur Röntgentherapie des Gesichtsfurunkels. (Roentgen treatment of furuncle of the face.) *Strahlentherapie*, 1933, *47*, 188–194.

In order to determine the value of roentgen treatment of furuncle of the face, the author made a study of 103 cases treated by irradiation and 103 non-irradiated cases. He found that in the cases treated conservatively the mortality was 10.7 per cent, while in the irradiated cases it was only 1.9 per cent. In both irradiated and non-irradiated cases the usual conservative methods were used. In 87 per cent of the cases the irradiation had a definitely curative effect on the disease. The pain, which is quite severe, stopped within a few hours after irradiation. The temperature fell either on the evening of the irradiation, or after a primary rise of 1 to 1.5° it fell by lysis the next day. The time required for treatment was shortened by the roentgen irradiation. There were no recurrences in the irradiated area, but in some of the cases new furuncles developed in other regions of the body. Irradiation, therefore, apparently does not bring about a general immunization, but the action is local. Roentgen therapy is to be recommended in furuncle of the face, both on account of the decreased mortality and the effectiveness in controlling pain.—*Audrey G. Morgan.*

Dyes, Otto. Grundlagen der Behandlung entzündlicher Krankheiten durch Röntgenbestrahlung. (Principles of treatment of inflammatory diseases by roentgen irradiation.) *Strahlentherapie*, 1933, *47*, 160–178.

The classical symptoms of inflammation—heat, pain, redness and swelling—are caused by complicated biological processes, which are discussed in detail. The bactericidal properties of extracts of liver and spleen can be increased by irradiation of normal guinea pigs, small doses being more effective than larger ones. The latter, in fact, sometimes decrease bactericidal action. Irradiation of the thyroid before experimental infection saved rabbits and guinea pigs from infections with typhoid, paratyphoid, colon bacillus and anthrax bacillus emulsions which killed the control animals. Autopsy did not show a trace of infection, which was attributed to mobilization of defensive substances by the reticulo-endothelial system. These, and other experiments, justify the prophylactic use of roentgen irradiation in inflammation, and also the irradiation of the spleen and liver, rather than of the local focus.

When two foci of inflammation are produced and one of them is irradiated, both are affected in the same way, showing that the action is not merely local. Experimental streptococcus abscesses have been cured by roentgen irradiation. In experiments in vitro irradiation has no effect on the pus. These facts indicate that the blood has active bactericidal properties after irradiation. Pfalz found the highest bactericidal property on the use of 17 to 18 per cent of a focal dose. There were different phases in the reaction. Four to eight hours after the irradiation a phase of decreased resistance was followed by one of increased bactericidal action. This was followed by a fall for eighteen to twenty-four hours, and finally by a permanent stair-step rise. This is just like the course of the protein body reaction, so that Pfalz, and others, assume that irradiation acts as a nonspecific stimulus resulting in activation of protoplasm.

The increase of defensive forces is attributed by some authors to increased activity of the cells in producing antibodies. This hyperfunction occurs as a regenerative stage after primary injury. In the histological picture of inflammation there is no great proliferation of the reticulo-endothelial cells or connective tissue, which could be interpreted as a primary stimulant action. After experimental typhoid infection of dogs, however, Businco observed active connective tissue proliferation and the formation of a natural wall made up of reticulo-histiocytic cells from the subcutaneous tissues around the necrotic focus. The storage capacity of the reticulo-endothelial cells in the liver and spleen is increased by small doses of irradiation and paralyzed by large ones. This increased activity indicates an increase not only of phagocytosis, but also of antigen production.

It is impossible to say whether the decrease in the number of inflammatory cells brought about by irradiation is the result of inhibition of the production of cells or by cell destruction. In view of the small doses used it seems impossible that cell death results from the direct action of the rays. The destruction of leucocytes sets free leucines which have a bactericidal action and the destruction of the reticulo-endothelial cell sets free proteolytic ferments. The liquefaction of infiltrations frees the small vessels from pressure and the bright red color of arterial hyperemia replaces that of stasis.

The results of experiment have been, to a certain extent, contradictory, and it is difficult to follow up and demonstrate all the complicated processes that take place. But apparently the action of roentgen rays is due ultimately to alkalinization of the tissues. The blood supply is improved and by increased permeability of the cell wall exchange between the constant hydrogen ion concentration of the blood and that of the inflamed focus is improved. With increased destruction of the cells larger amounts of albumin bodies are set free, and acidosis temporarily increased. The special advantage of roentgen treatment lies in the fact that therapeutic changes can be brought about at a much earlier stage than with surgical treatment. The classical symptoms of inflammation can be combatted from the very beginning by roentgen treatment.—*Audrey G. Morgan.*

Schwarz, G., and Frank, A. Konfluierende Follikulitis mit Pseudotumorbildung bei Radioepidermitis sicca. (Confluent folliculitis with pseudo-tumor in radioepidermitis sicca.) *Strahlentherapie*, 1933, *47*, 195–200.

With the present tendency to use large doses of radiation, there are apt to be intense skin reactions. The authors describe a case in which a patient seventy-seven years of age was ir-

radiated for carcinoma of the left tonsil. From October 7 to 22, 1932, a dosage of 2,500 r was given on the chief field on the left side. From October 23 to November 9, a dose of 3,000 r was given on the right side. From November 10 to 17, 1,000 r was given over a dorsal field on the nape of the neck, and finally another dose of 2,800 r was given on the left field, making a total of 5,300 r applied directly to this field. The daily dose was 200 r given in the course of 20 minutes with 160 kv., 3 ma. and a filter of 0.5 mm. Zn and 1 mm. Al, distance 40 cm. The tumor disappeared and the patient recovered his general health. There was a very intense skin reaction with complete exudative epidermitis on the left side. The reaction was milder on the right side and showed only a dry epidermitis. After a time, however, a pustule developed on the right side, and by confluence with other pustules an ulcerated tumor developed that had all the appearance of malignancy. The patient refused operation or even exploratory excision. Soon, however, spontaneous recovery began, and twenty-six days after the appearance of the first pustule there was no longer any tumor, and the ulcer soon healed completely.

This was not a gland metastasis of the tumor, as was first feared, but a confluent folliculitis in an area that had been subjected to intense irradiation. It is important to know the possibility of such results as it may prevent mistaken diagnoses and treatment.—*Audrey G. Morgan.*

Küpferle, L. Die Röntgenstrahlenbehandlung der Blutkrankheiten. (Roentgen treatment of blood diseases.) *Strahlentherapie*, 1933, *47*, 179–187.

Roentgen treatment is effective in two groups of blood diseases, granuloma, particularly malignant granuloma or Hodgkin's disease, and the myeloid and lymphatic leucemias, which are caused by excessive proliferation of lymphatic or myeloid tissues. Both of these forms of leucemia are generalized systemic diseases. Permanent cure cannot be brought about but the excessive proliferation can be kept under control, often for years. The task of roentgen treatment is to preserve this normal balance for as long a time as possible. The severity of the disease is determined not so much by the extent of proliferation as by the rapidity with which new cells are formed in the metaplastic myeloid or lymphatic tissues. This is manifested by the numbers of immature cells appearing in the blood. If many myeloblasts appear in myeloid leucemia, or many lymphoblasts in lymphatic leucemia, it indicates an acute course of the disease and an unfavorable prognosis. Roentgen irradiation should be used with caution in these acute cases. In the more ordinary chronic cases there are only a few myeloblasts or lymphoblasts in the blood, and in these cases roentgen treatment is very hopeful.

Formerly an attempt was made to reduce the blood count to normal and decrease the size of the enlarged spleen, liver and lymph nodes by giving relatively large doses (one-third of a skin erythema dose) at short intervals. This method was too severe and frequently resulted in injury of the erythropoietic system, with anemia and hemorrhagic diathesis. Dosage must be so regulated as to reduce the leucocyte count gradually without injury to the organs which produce red cells. This can be accomplished by the use of small doses at rather long intervals, the details being determined by the reactions shown in the blood picture. Lymphatic tissue is more sensitive to irradiation than myeloid, and myeloid more sensitive than erythroblastic tissue. In myeloid leucemia the bone marrow should be irradiated and the spleen protected. In lymphatic leucemia, the enlarged glands should be irradiated, though both are systemic diseases and the therapeutic action probably takes place through the blood. Treatment should be begun with small doses of not more than 10 to 15 per cent of a skin erythema dose, or 54 to 90 r, with suitable deep technique: focus skin distance 30 cm., surface 10×15 cm., primary irradiation 170 to 180 kv., filter 1 mm. Al and 1 mm. Cu. The dose may be increased to 20 per cent of a skin erythema dose as the tissues become less sensitive, though this decrease of sensitiveness can be overcome to a certain extent by changing the fields. The treatment should be prolonged for months. If more than 10 per cent myeloblasts appear in the blood, radiotherapy should be discontinued. Constant observation of a red blood picture is of great importance as is that of the white count. A decrease of hemoglobin content and erythrocytes indicates the necessity for a change in the plan of treatment.

Roentgen treatment is also effective in erythemia. The bone marrow should be irradiated

and the spleen protected because of its action in destroying red cells. Larger doses of 20 to 25 per cent of a skin erythema dose must be used with intervals of two to three weeks between treatments.

In malignant granuloma histological examination of the glands as well as the blood picture is necessary for a diagnosis. The cervical mediastinal or abdominal glands may be enlarged. Combined arsenic and roentgen treatment should be used. Only 10 to 15 per cent of an erythema dose should be applied to one field, and the same amount to a second field after one to two weeks. It is rarely necessary to increase the dose to 20 per cent of a skin erythema dose.—*Audrey G. Morgan.*

Pfahler, George E. Irradiation treatment of hyperthyroidism. *Ann. Int. Med.*, Jan., 1934, *7*, 868–884.

Irradiation is indicated in all cases of hyperthyroidism in which the patient is not in crisis, or is not suffering from definite pressure symptoms. Surgery is advisable in all simple or nontoxic goiters but in the presence of some contraindication, a moderate amount of irradiation may be used. Irradiation possesses the following advantages: (1) eliminating the fear of operation; (2) causing no pain or shock; (3) has no mortality risk; (4) causes no scar; (5) frequently is unattended with interruption of occupation; (6) may be employed in the presence of advanced disease or serious heart complication, and (7) has end-results approximately equal to those of surgery. The disadvantages to be considered are: (1) telangiectasis and skin atrophy; (2) exacerbation of symptoms after first treatment; (3) slow response to treatment, and (4) permanent cardiac impairment developing during the prolonged application of the method. Other mentioned disadvantages as burns, myxedema, damage to the parathyroids and difficulty in subsequent surgical removal, are not tenable objections.

The author routinely employs roentgen rays, using 130 kv., 5 ma., at 25–30 cm. distance, with the equivalent of 6 mm. of aluminum filter. Four fields, approximately 5×15 cm., are outlined in the cervical region, two anterior and two posterolateral, the lower border extending downward over the thymic region. The larynx is protected with lead. The rays are directed downward and medial to obtain a cross-fire effect in the thyroid region. The four areas, constituting one series, are usually given in one day, and repeated in three, then four weeks, and at subsequently increased intervals according to improvement obtained. In the mildly toxic cases an initial 50 per cent skin erythema dose is given to each portal while in the more severe cases, smaller doses are used. If definite improvement does not follow 3 or 5 series and a lapse of two or three months from inauguration of the treatment, other measures are indicated. Careful physical check is made of the patient, foci of infection are removed and quininehydrobromide, 5–10 grains, three times daily, is administered unless tinnitus occurs. Rest is advised and a high caloric diet of easily digested food is recommended. Stimulants, sun burn and irritating salves and lotions are interdicted. Iodine has not been found helpful.

Brief reports of 37 chronological cases are presented in which there was no definite thyroid enlargement but in which the diagnosis had been made by eminent clinicians. Of these 29 had economic restitution, in 5 the treatment failed and 3 could not be traced.

Radium has been used in only a few cases but it is felt that results as good may be obtained with this agent as with roentgen rays.—*W. R. Brooksher.*

Huet, J.-A. La radiothérapie de l'hypophyse curatrice des troubles fonctionnels de la ménopause. 33 observations. (Curative radiotherapy of the hypophysis for functional disorders of the menopause; 33 observations.) *Bull. et mém. Soc. de radiol. méd. de France*, July, 1933, *21*, 561–564.

The author briefly reports a series of 33 cases which were treated during the past three years for functional disorders brought on by the artificial or natural menopause. The pituitary gland was irradiated in every instance with the following technique: 3,000 r in six seances of 500 r each, given twice weekly with 120 kv., 8 mm. Al, 25 cm. spark gap, three ports of entry having been used. The most frequent disorders were hot flashes, perspiration, palpitation, rheumatic pain, crises of anxiety, profuse diarrhea and especially psychic phenomena. The good results were observed already after the administration of 2,000 r. It seems that irradiation acts in the first instance on the thyrotrope function of the hypophysis and then on the function of the center of metabolism. The 33 cases are briefly enumerated.—*T. Leucutia.*

Pĕcurariu, Ovidiu. Tratamentul boalei lui Basedow. (Treatment of Basedow's disease.) *Cluj. men.*, Nov., 1933, *14*, 616–621.

The author in this article reviews 242 cases of Basedow's disease which were observed and treated by various methods at the medical clinic of the University of Cluj during the past ten years. Eighty-one of the cases were treated medically, with rest and various medications, chiefly iodine therapy; 146 cases were subjected to radiation therapy, and 15 cases were operated upon. Radiation therapy was carried out by administering one-third of a skin unit dose on each of the three fields at weekly intervals, with 120 kv., 4 mm. Al, 2 ma., the series being repeated after six weeks, depending on the basal metabolism.

The following general conclusions are reached: Medical therapy, especially the administration of iodine, is indicated in preoperative cases, an amelioration being quite frequent, sometimes lasting for half a year to two years. Radiation therapy necessitates a longer time, the great ameliorations and cures observed by the author occurring only in those cases in which the therapy extended over a long period. It is interesting that a recurrence was exceedingly rare in those cases which were benefited by radiation therapy. The surgical treatment has given the largest percentage of final cures.—*T. Leucutia.*

Phillips, G. White. Myeloid leukemia treated with the four-gramme radium bomb. *Lancet*, Jan. 7, 1933, *1*, 22–24.

The author describes a case of myeloid leucemia in which the spleen only was treated with the bomb consisting of 200 tubes of 200 mg. each, arranged in a horizontal circle with a radium-skin distance of 9 cm. The total filtration was equivalent to 1 mm. platinum and the portal of entry was a circle 15 cm. in diameter. Radiation was carried out from front and back, exposures of two hours daily for seven days, a total of 56,000 mg-hr. being given. Following the treatment, the white cells were reduced from 338,000 to 61,000 and the decrease continued for some time after cessation of the treatment. There was general improvement of the patient. Six months later, the spleen having become enlarged to its previous size, and the white cells being 186,000, 20,000 mg-hr. was given from the front only with a resultant decrease in the white cell count. Blood counts during this treatment showed a drop of 20,000 white cells after one hour's treatment with the bomb. Four months later, the clinical symptoms had recurred with additional general deterioration and 32,000 mg-hr. was given. Two months after this last treatment his general condition was very good and the total leucocytes were but 26,000. Ten weeks later the bomb was applied for one hour on each of three days in front because of recurrence of fatigue and shortness of breath, the leucocytes being 123,000, dropping to 105,000 two weeks after this treatment. Two years after the first radium treatment he had phlebitis in both legs but was reported to be improving. Deep roentgen therapy had been administered to the spleen, the radium bomb not being available, reducing the leucocytes to 19,000.—*W. R. Brooksher.*

Staicovici, Ev., Jovin, I., and Schlesinger, Al. Indicatiunile si tehnica aparatelor purtătoare de radium în tratamentul tumorilor maligne ale cavitătii bucale. (Indications and technique of radium application in the treatment of malignant tumors of the buccal cavity.) *Cluj. med.*, Sept., 1933, *14*, 489–498.

This article constitutes a review in summary of the procedures and indications of various types of radiation therapy (external roentgen therapy, radium puncture, use of radium applications) in the treatment of various malignant lesions of the buccal cavity. Great stress is laid on the intraoral molds which are used extensively for the support of radium tubes. The following general procedures are advised: (*a*) operable cases, especially when radioresistant, should be submitted to surgery; (*b*) in borderline cases local radium therapy with surgical removal of the regional glands followed by postoperative irradiation is the method preferred; (*c*) in the inoperable cases radium or roentgen therapy should always be attempted.—*T. Leucutia.*

Cade, Stanford. Radiation treatment of cancer of the mouth and pharynx. *Lancet*, July 1, 1933, *2*, 4–12.

This, a Hunterian lecture before the Royal College of Surgeons, details the treatment for the following lesions: tongue, cervical lymphatic area, oropharynx, hypopharynx, and the maxillary antrum. Cade has arrived at the following conclusions:

1. Histologically similar tumors present wide differences in their response to irradiation —there must therefore be other factors besides actual structure as seen under the microscope which affect the response of tumor cells to irradiation.

2. The condition of the stroma is as important as that of the nature of the cells.

3. Anatomical situation has a definite relation to radiosensitivity, irrespective of histological structure.

4. Radiosensitivity bears a direct relation to the local lymphatic and blood supply.

5. Sepsis increases radioresistance.

6. Anemia, other factors being equal, increases radioresistance.

7. Thus, the choice of treatment depends upon (1) the site and extent of the disease, (2) the type of lesion, (3) the general condition of the stroma and (4), the general condition of the patient.

In early growths of the anterior portion of the tongue, local excision or irradiation offers little choice for good results. In the posterior portion, behind the circumvalate papillae, the lesion is beyond surgical help and the reasons for irradiation are: (1) inaccessibility of lesion to surgery without grave risk to the patient, (2) the malignancy of these tumors is high and (3), dissemination is early and widespread. In the palate, buccal mucosa and floor of the mouth the immediate results of irradiation are at least as good as those of surgery inoperable cases and greatly superior in the inoperable group.

Treatment of the cervical lymphatic area is imperative in oral and pharyngeal cancer even when the neck appears normal. The routine treatment of Wallace is accepted: (1) if no glands are palpable, surface irradiation is employed; (2) (*a*) if the glands are palpable but operable, and if the condition of the patient is good, and there has been a good local response, they are removed by block section; (*b*) if removal of glands is not advisable, open or closed needling is employed; (3) if the glands are inoperable, they are given the primary treatment by deep therapy, followed by either needling or surface irradiation with radium.

Radiation is the treatment of choice in the oropharynx, disappearance of the primary lesion occurring in about 90 per cent of the cases if adequately treated.

In the hypopharynx with suitably selected cases and a surgical technique of the highest order, the extirpation of the pharyngeal neoplasms is possible with brilliant results by Trotter's transthyroid pharyngotomy. Such cases and successful issue of surgery are few and it is then that radiation methods offer the only hope of either palliation or cure.

Radiation treatment of maxillary antral tumors, if adequate, gives gratifying results. The method used depends upon the histological structure and a biopsy is therefore of prime importance. If sarcoma, roentgen rays without surgical intervention are unequalled. If carcinoma, preliminary roentgen irradiation must be followed by radium treatment. In antral carcinoma it is important to expose the growth for (1) irradiation by radium, (2) drainage and (3) a permanent inspection window.

The combination of roentgen rays and radium is stressed because a greatly increased tissue dose may be given, greater than by either method alone and because it appears that radiation of different wave lengths increases the radiosensitivity of a tumor. The methods of treatment, in particular mass radiation, are fully discussed. Illustrative cases are reported and one color plate accompanies the article in addition to a number of photographs and diagrams.—*W. R. Brooksher.*

Popp, L. Un caz de micoză leptotrixiană tracheală vindecată prin radioterapie. (A case of tracheal leptothrix mycosis cured by radiotherapy.) *Cluj. med.*, July, 1933, *14*, 406–408.

Leptothrix mycosis is characterized by small pea-sized prominences of the invaded mucosa, of a whitish discoloration and without producing much pain or discomfort to the patient. The most common localization is the upper respiratory tract chiefly the oral cavity, nasal cavity, pharynx and tonsillar fossae. However, when the lesion extends into the trachea, which is exceedingly rare, some very serious symptoms may appear, consisting chiefly in cough, irregular rise in temperature and occasionally bleeding. The author had the opportunity to treat such a case with roentgen therapy, the result being prompt and lasting. The case is that of a boy eighteen years of age, who was previously treated with all kinds of conservative methods without the slightest sign of imtherapy was advised by his attending otolaryngologist. The treatment was carried out with

two series given about six weeks apart. Each of the series consisted in the administration of 200 r on the anterior field the first day, 200 r on the posterior field the second day, 250 r on the anterior field the third day and 250 r on the posterior field the fifth day, with roentgen rays of the following quality: 170 kv., 6 mm. Al as filter, the skin target distance being 30 cm. and the intensity of the current 4 ma. An immediate improvement was observed following the first series and shortly after completing the second series a complete cure resulted which has now lasted for more than two years.

The case is interesting because of its exceeding rarity and because of the good response to radiation treatment.—*T. Leucutia.*

Pack, Geo. T. Surgical and radiation treatment of gastric cancer. *South. M. J.*, Sept., 1934, *27*, 747–754.

The etiological factors and diagnostic difficulties are discussed. Partial gastrectomy is the method of choice in the treatment of gastric cancer, and is employed not only as an attempted curative measure for cancers classified as operable, but occasionally for palliation in cases classed as inoperable because of metastasis. The type of resection and the method of anastomosis must depend more or less on local conditions. The two-stage resection is not considered advisable unless pyloric obstruction is a prominent symptom. Total gastrectomy should be employed more frequently although attended with a high operative mortality, as 15–20 per cent of all gastric cancers are found confined within the limits of the stomach at necropsy. An attempt has been made to overcome the handicaps of gastro-enterostomy employed for stenosing pyloric and antral cancers by performing gastroenterostomy together with an exclusion of the pyloric or antral cancer. This excludes the cancer from the gastrointestinal circuit, relieving the ingested food from contamination, avoiding extension to the new stoma and allows infection to subside. The excluded segment may then receive palliative irradiation either from extrinsic source or by implantation.

Difficulties with irradiation are due to the high incidence of radioresistant tumors present, inaccessibility of the organ, proximity of the stomach to organs sensitive to radiation, the effects upon which lead to severe and prolonged radiation sickness, and the daily use of the stomach while under treatment makes it less tolerant to irradiation.

Gastric cancers selected for irradiation are only those which are inoperable either because of the extent of the disease or the region involved. As most radiosensitive gastric cancers are situated in the cardia and fundus (20 per cent at Memorial Hospital), there has been little conflict with the decision for irradiation over surgery. The ulcero-cancers, the diffuse superficial carcinomas and the bulky adenocarcinomas occurring, especially in these localities, show regression after suitable irradiation. Certain rare small cell carcinomas resemble lymphosarcoma in their response to roentgen and radium therapy.

Radon implantation into the growth at laparotomy is followed by external high voltage roentgen rays or radium pack, the technique for which is detailed. The operative procedure is completed with a Janeway gastrostomy, which is permanent and permits feeding when the cardia is occluded and while under treatment, permits observation of the growth by retrograde gastroscopy, and insertion of additional implants.—*W. R. Brooksher.*

Wintz, H. La Röntgen-terapia del carcinoma ovarico. (The roentgen therapy of carcinoma of the ovary.) *Arch. di radiol.*, 1932, *8*, 312–344.

The author reports 122 cases of carcinoma of the ovary irradiated between 1916 and 1928. In the cases treated surgically followed by two applications of irradiation there was survival and freedom from recurrence after three years in 40 per cent of the cases, after five years in 25 per cent of the cases.

The difficulties in irradiation of carcinoma of the ovary are discussed. The whole area of diffusion of the tumor should be irradiated and for tumor of the ovary this means the whole of the pelvis and lower quadrant of the abdomen. If a dose large enough to cure the tumor at once is applied over so large a field it results in serious injury to the blood. If the dose is fractionated it loses a great part of its biological effectiveness. For instance, if 42 per cent of an erythema dose is applied to the lower abdominal field and two days later 45 per cent of an erythema dose the total applied to the deep tissues is not 87 per cent but about 20 per cent less than that. Coutard has shown that with the use of fractional doses the skin can bear

about five times as much irradiation as if it were applied in a single large dose. In the treatment of cancer this is a great disadvantage because this recuperative capacity of the cancer cell is even greater than that of the normal cell; moreover between the applications it has time to adapt itself to the action of the rays. This decreases the radiosensitiveness of the carcinoma cell as compared with that of the normal cell and it is on this comparative radiosensitiveness that the whole treatment of carcinoma is based. Coutard's method therefore is absolutely inapplicable to the treatment of carcinoma of the ovary. The total dosage should not be distributed over a period of more than three days. Individual care based on careful measurements is of the greatest importance. In view of the injury to the organism by the products of disintegration of the tumor as much as possible of it should be removed surgically.—*Audrey G. Morgan.*

Ducuing, J., and Guilhem, P. Curiethérapie du cancer du col et température. (Curie therapy of cancer of the cervix and temperature.) *Presse méd.*, July 8, 1933, *41*, 1081–1083.

In this article the authors analyze the cause of the elevation of temperature which is often observed in cases of cancer of the cervix and its importance from the point of view of local application of radium.

I. The temperature in cancer of the cervix before treatment. At the Anticancer Center of Toulouse an elevation of temperature was observed in 60 out of 100 cases of cancer of the cervix admitted for treatment. The causes of this elevation of temperature were numerous, variable and of unequal importance. Around the cervix, an infected ulcer or a cervical metritis may lead to a slight fever which usually is not very serious. At the level of the fundus pyometritis, salpingitis, lymphangitis, phlegmon of the large ligaments, phlebitis, etc., may produce an elevation of temperature which is considerably more serious.

II. The temperature in cancer of the cervix during the course of treatment with radium. An elevation of temperature during the actual application of the radium is nearly constant. It is the authors' opinion that the radium acts as a traumatizing and obstructing foreign body on the uterus and that this brings about the elevation of temperature. It appears that young patients are more predisposed to infectious accidents than those who have passed the menopause. This may be due to the fact that in more advanced age the sclerosis of the uterus acts as a protecting factor.

III. Curie therapy in relation to fever. (1) Prophylaxis or treatment of fever before curie therapy. It is advised that every infected cancerous patient be hospitalized and treated for a certain period for the infection present. The injection or local application of vaccines has not proved very satisfactory and therefore one must resort to the established conservative methods. The authors proceed as follows: The patient is put to rest and for a period of a week warm water is applied in the form of douches, enemas and external applications. In case of fungating masses, they apply diathermy coagulation but it must be stated that this is carried out with great care. Then the patient is prepared for irradiation by gradually dilating the cervix, which is done by the Hegar method. (2) Choice of proper technique of curie therapy to forestall fever. If the temperature has become normal and after the cervix has been properly dilated, twenty-four hours following the last seance of dilatation the radium tubes are introduced, being placed in the upper portion of the vagina and endocervically. Every two days the tubes are taken out, cleaned, the vagina disinfected and after a rest of twenty-four hours reapplied. (3) Procedure when the fever appears during the course of treatment. The application of radium is interrupted as soon as the temperature exceeds 38 to 38.2° C. The patient is then observed for the various causes or complications and the radium is not reinserted until a normal temperature is again obtained.—*T. Leucutia.*

Healy, William P. Experience with radiation therapy in cancer of the cervix. *Am. J. Obst. & Gynec.*, Sept., 1934, *28*, 386–391.

Three thousand cases of cancer of the cervix at Memorial Hospital, New York, from 1916 to 1933 are analyzed, of which 2,500 were classified as primary and the remainder as secondary or recurrent. A possible relationship between cervical injury during labor and the subsequent onset of cancer in the damaged tissues is suggested by the fact that all but 4 or 5 per cent of these patients have given birth to children. The Schiller iodine test may be helpful as a diagnostic aid in early cases but is not appli-

cable to a suspicious ulceration or erosion as it is of value only in the presence of squamous epithelium. A negative test does not rule out the possibility of carcinoma in the deeper portions of the cervix not involving the surface epithelium. The five year cure of all cases was 22.6 per cent. In 64 treated cases of carcinoma of the cervical stump the salvage was but 14 per cent; 2.1 per cent of cervical cancers treated by radiation may be expected to develop post-irradiation trophic ulcers of the bladder, usually responding to local treatment. Advanced disease, absence of the uterus, interstitial irradiation used at the time of the primary treatment and re-treatments apparently increase the tendency to fistula formation. Deep roentgen therapy prior to the application of radium in advanced cases will materially clean up the primary lesion. In an effort to more efficiently care for the parametrial extension of the disease, roentgen therapy in increased skin dosage to obtain a greater intensity of effective radiation in the deep pelvic tissues by the use of multiple small daily doses with increased target skin distance has been employed. The pelvis is divided into a right and a left half and each half into a anterior and posterior field. The two fields in one-half of the pelvis are given 200 r to each field at 70 cm. on one day, and to the two fields in the other half the following day. This is continued until each field has received 1,000 r, when the daily dose is increased to 300 r, until an additional 1,500 r has been given to each of the four fields. It is estimated that this gives the parametrial structures 10 cm. below the skin surface about two-thirds of the total skin dose. Skin reactions were marked in 10 per cent, moderate in 80 per cent, and slight or absent in 10 per cent of the cases treated. Radium in full dose has been applied to the primary lesion at the conclusion of roentgen therapy.—*W. R. Brooksher.*

Mallet, Lucien. Radiothérapie des tumeurs testiculaires et survie des malades. (Radiotherapy of testicular tumors and survival of patients.) *Presse méd.*, Sept. 9, 1933, *41*, 1402–1404.

The efficacity of radiation therapy being subordinated to the radiosensitivity of the cellular elements, the author divided testicular tumors into two groups: (1) the seminiferous epithelioma or seminoma which histologically is characterized by rather uniform cells and limited by a more or less thick and well vascularized conjunctival stroma, and (2) the mixed tumors which include all varieties of tissues originating from the degenerated testicular "dysembryomas." In a series of 15 cases observed by the author, histological examination was made in 10. Six of these proved to be mixed tumors, 5 patients having died within one year and one still being alive after eight years, and 4 seminomas, one having died after eighteen months and 3 being alive after six, nine and ten years respectively. Of the remaining 5 cases in which no microscopic examination was made, 3 survived for two to three years, one died after three years from pneumonia, and the fifth was lost track of.

A table showing the duration of survival in all 15 cases and the case reports of 4 cases showing various rates of sensitivity are briefly included. All cases were treated rather extensively with radiation therapy, 3,000 to 4,000 r, with 200 kv., 1 mm. Cu, being administered over each field, the series comprising fifteen to twenty days. It is the present impression of the author that because of the rapid development of distant metastases in such instances localized irradiation is of little value but must always be associated with generalized teleroentgen therapy with small doses extending over a prolonged time. The great radiosensitivity of the seminomas suggests in this respect a technique similar to that used in leucemias or lymphogranulomatosis. If the tumor once produces abdominal metastases, in case of seminoma radiation therapy must always be resorted to while in case of a mixed tumor, because of poor radiation response, a surgical intervention with removal of the abdominal mass is to be preferred; this then is followed by prophylactic postoperative irradiation.—*T. Leucutia.*

MISCELLANEOUS

Ramirez Corria, C. M., and Stuhl, Louis. L'opacification radiographique des processus en foyer provoqués dans l'encéphale par traumatismes expérimentaux. (The roentgen opacification of focal processes provoked in the brain by experimental traumatism.) *Bull. et mém. Soc. de radiol. méd de France*, June, 1933, *21*, 440–444.

Ramirez Corria for several years has studied the action of the vital stains on the microglia of Rio Hortega and during this study he has found that certain substances such as trypan

blue, carmine, china ink, etc., have the property that they are stored in vivo by the reticulo-endothelial system. This property is quite general so that the entire system may be stained or tattooed, the brain forming no exception. It has been found that the intracranial elements chiefly involved in the process are: the cells of the meningeal mesenchyme, the hypophyseal sinuses and, if larger doses are administered, the vascular adventitia and a few intra-encephalic capillaries. The hemato-encephalic barrrier is not traversed by the stains; neither are the glial cells or the neurones colored. The microglia, that veritable reticulo-endothelial system of the nerve centers in a normal state, that is, at rest, does not take the vital stain, but if one excites its ameboid or phagocytic capacities either by experimental inflammation or by trauma, the hemato-encephalic barrier is broken and the microglial elements become stained. Macroscopically there is a pronounced contrast between the inflammatory focus colored by the vital stains and the normal unaltered parts of the brain.

With the above facts as a starting point, the authors analyzed the effect of the metal colloids, opaque to roentgen rays, on traumatic foci of the brain to find out if their demonstration through deposit of these substances within them is possible. They proceeded as follows: A necrotic focus was produced within the brain of rabbits by means of a heated needle which was introduced through an intracranial puncture. Immediately or a few days later thorium was injected intravenously in various quantities and by repeating the dose. Roentgenograms of the skull later demonstrated a very distinct opacity corresponding to the provoked traumatic cerebral focus. Microscopic investigations, on the other hand, revealed that this opacification was the result of actual deposit of the colloidal thorium.

In another series of experiments, the injection of the thorium was performed by the intraspinal route and similar results were obtained, although this phase of the investigation is not as yet entirely complete. Radovici and Meller, with a different view in mind, have injected thorium by the intraspinal route in man before but since these authors have failed so far to publish anatomic data it is not yet proved whether the phenomena occur in the human in the same way as in animals. One must mention that the meningeal impregnation with vital stains, even in the absence of meningo-encephalic lesions, may produce late nervous accidents.

However intriguing these experiments may appear, their application in the human for the roentgen exploration of the brain must still await time. The chief drawback in this respect is the fact that metal thorium is eliminated exceedingly slowly and that it may lead to certain damaging effects.—*T. Leucutia.*

Radovici, A., and Meller, O. Liquidographie d'un foyer de ramollissement cérébral par le thorium colloïdal. (Liquidography of a focus of cerebral softening by colloidal thorium.) *Bull. et mém. Soc. de radiol. méd. de France*, June, 1933, *21*, 444–445.

In previous articles the authors presented the results of their experimental investigations on encephalo-myelography by means of colloidal thorium. Later the method was extended to humans by adopting the following technique: 10 c.c. of colloidal thorium is injected, following the withdrawal of the same amount of cerebrospinal fluid, by the suboccipital route. The intermixing of the substance with the cerebrospinal fluid is obtained by placing the head in a declining position. The roentgenograms of the skull are then made with the routine incidences. The results obtained so far are encouraging inasmuch as they permit the visualization of certain parts of the brain which cannot be demonstrated by other encephalographic methods. Recently the authors observed a very interesting phenomenon which forms the subject of this publication, by practicing liquid encephalography in a demented woman, aged fifty-five. The patient died six months later as a result of pneumonia and a necropsy of the brain revealed, apart from syphilitic meningo-encephalitis, a large focus of softening in the right frontal lobe. A roentgenogram of the brain showed that the focus was impregnated with colloidal thorium. A re-examination of the original roentgenograms made in vivo a few days after the injection in the light of this new development showed that the impregnation of the focus had already commenced at that time. The mechanism of the thorium in the softened cerebral tissue is not easy to explain but the authors hope to obtain additional information from the microscopic study.—*T. Leucutia.*

Egas Moniz, Almeida Lima, and Diogo Furtado. Trouble circulatoires du cerveau

produits par des tumeurs cérébrales dans le voisinage du siphon carotidien. (Circulatory disorders of the brain produced by cerebral tumors in the vicinity of the carotid sinus.) *Presse méd.*, July 12, 1933, *41*, 1104–1106.

For a long time the authors suspected the existence of circulatory disorders produced by compressing tumors at the entry of the internal carotid into the cranium. Since the introduction of serial angiography of the cerebral circulation (with 12 to 16 c.c. of thorotrast injected inthe inferior portion of the common carotid) they were able to verify this disturbance in the circulation.

In this article, 4 cases relating to pressure of brain tumors on the carotid sinus are briefly presented and illustrated with typical roentgenograms. It was observed that whenever there is impairment of the cerebral circulation because of pressure on the carotid sinus, the speed of injection of the thorotrast in the internal carotid is greater than that of the blood, this resulting in two phenomena: First, the injection is unable to force the obstacle at the point of pressure, in which case only the lower portion of the sinus is demonstrated on the roentgenograms; secondly, the circulation aided by the force of the injection overcomes the pressure and passes into the cerebral circulation, in which case the intracerebral carotid plexus appears faintly visible on the films. The authors use the so-called "merry-go-round" of Caldas for taking serial roentgenograms, which is a table permitting the successive exposure of six films at one second intervals. If no such table is available, the following procedure is advised: When a first roentgenogram taken immediately after the injection of the thorotrast in the common carotid fails to demonstrate the carotid sinus, one should repeat the injection and take the roentgenogram one second (instead of immediately) after the termination of the injection. This latter roentgenogram will demonstrate the arterial plexus of the brain derived from the internal carotid.—*T. Leucutia.*

Reboul, Henri, and Racine, Maurice. La ventriculographie cardiaque expérimentale. (Experimental cardiac ventriculography.) *Presse méd.*, May 10, 1933, *41*, 763–767.

Angiopneumography, even in its more recent form, has not fulfilled the hopes that it has raised. During the course of time the various authors have devised several methods which can be classified briefly into: (1) direct injection of the right ventricle by puncture; (2) injection of the efferent veins of the right auricle, and (3) injection of the right cavities of the heart and occasionally of the pulmonary artery after introduction of a catheter through the cubital veins. It may be said that the third method was endorsed by most investigators because of its greater safety.

The authors since March, 1932, have been experimenting on dogs with the first method, that is, with direct injection of the ventricles of the heart by puncture through the thoracic wall. In this article they present in retail the armamentarium, as well as the technique of procedure and include several illustrations showing a remarkable filling of the various cavities of the heart and great vessels with the opaque medium. The inconveniences of the method are that general anesthesia must be used, and that the amount of solution which can be injected into the heart without producing a severe shock must be chosen carefully.

The conclusion is reached that the authors' technique gives results which are truly remarkable by their precision and constancy, and that both a left and right ventriculography is possible. Furthermore the method permits the experimental roentgen study from the triple standpoint of anatomy, physiology and pathology of the ventricles and their orifices, of the thoracic portion of the aorta and its branches and of the pulmonary artery. It must be mentioned, however, that so far the method has not been tried in the human.—*T. Leucutia.*

Racine, Maurice, and Reboul, Henri. Les modifications électro-cardiographiques au cours de la ventriculographie cardiaque gauche expérimentale. (Electrocardiographic modifications during the course of experimental left cardiac ventriculography.) *Presse méd.*, June 14, 1933, *41*, 950–952.

In a previous article (see above abstract)the authors indicated the advantages of a new method of roentgen exploration of the ventricles of the heart as well as of the thoracic aorta and pulmonary artery. Among the disadvantages was mentioned chiefly the severe shock which was produced if the amount of the solution injected was too large. In connection with this it was found that if only 20 c.c. were injected under a pressure of 2.25 kilograms, even after repetition of the injection within a few

hours, the disorders were temporary, whereas the injection of 7 c.c. under a pressure of 1.25 kilograms produced no shock whatever and still led to excellent images. Before applying the method to humans, the authors thought it indispensable first to experimentally determine the dangers which may be incurred to the muscles of the heart during such a procedure. For this purpose they used electrocardiography and in this article they present the results of their investigations on dogs, which are as follows: The opaque solutions utilized during the course of the experiments in various concentrations have produced the same modifications which are observed from physiologic serum assuming that an equal volume was injected. The experiments were carried out with volumes not exceeding 20 c.c., since larger amounts do not come into consideration for cardiac ventriculography. In further experiments it was found that the pressure under which the injection is made is of greater importance than the volume. To obtain a good left cardiac ventriculography in a large dog of more than 20 kg. about 7 c.c. of tenebryl of 45 per cent concentration is injected under a pressure of 1 kg. to 1.25 kg., the duration of the injection varying from between 1 to 2 sec. The injection of larger volumes of fluids under higher pressure leads to extrasystoles, paroxysmal tachycardia and irregular arrhythmia of the heart. This proves that there is an upper limit of safety which must not be exceeded when injecting the cavities of the heart. The determination of this upper limit in the human before proceeding with the ininjection is a very important one. Further studies will be carried out along this line.—*T. Leucutia.*

Conte, E., and Costa, A. Observations sur l'angiopneumographie. (Observations on angiopneumography.) *Presse méd.*, May 10, 1933, *41*, 767.

In considering the results of angiopneumography obtained so far, it is undeniable that the concentrated solutions of iodine form the best opaque substances, but their use in clinical practice is not devoid of inconveniences. Thus, the authors observed in an entirely healthy young man, twenty-five years of age, the appearance of a very intensive, although temporary, tetanic shock immediately following the injection. The shock involved the musculature of the trunk and extremities and was accompanied by slowing down of the respiration which caused not a little anxiety. It is the authors' impression that the shock was the result of iodism caused by the free iodine contained in the sodium iodide solution. In consequence they have tried to find another solution which although maintaining the advantages would eliminate the inconveniences caused by the presence of the iodine. After a number of experiments they prepared 10 c.c. ampules of a solution of 100 per 100 of 10 gm. abrodil and 2 gm. sodium iodide. Since abrodil contains 52 per cent iodine in a 100 per cent solution and sodium iodide 0.84 per cent in a 100 per cent solution, the entire amount of the ampule corresponds to 7 gm. iodine. This solution was used in a rather large number of cases and one of the authors applied it on himself, with excellent clinical results and without any inconveniences. The iodine concentration of the abrodil-iodide solution is less than that of a 120 per cent sodium iodide solution, leading thus to a somewhat lesser opacity, but this can be compensated for by injecting the fluid more rapidly, or still better, by injecting the cavities of the heart simultaneously through twosounds, one introduced through the veins of the left and the other of the right arm.—*T. Leucutia.*

Ravina, A., Sourice, A., Lesauce, J., and Godlewski, G. Retentissement cardio-vasculaire des injections de substances de contraste. (Cardiovascular retention of the injections of contrast substances.) *Presse méd.*, June 14, 1933, *41*, 948–950.

For a period of two years the authors have experimented on the roentgen visibility of the cavities of the heart by the injection of opaque substances, particularly of iodine compounds and thorium. During the first experiments a certain number of animals were lost as a result of the damaging effect of the injected solutions. Reboul and Racine likewise reported 5 mortal accidents among their dogs, and Conte and Costa described some rather serious although temporary accidents after injection of sodium iodide in the right cavities of the heart in human (see above abstract). In view of these the unfortunate occurrences the authors undertook the task to determine experimentally whether such accidents are due to the chemical nature or to the physical state (concentration, colloidal state, suspension) of the substances injected, or, whether the rate of injection is the responsible factor.

Six experiments are briefly described, the following general conclusions being reached: A rather large number of opaque substances are relatively well supported even when injected in the right cavities of the heart. A number of dogs have received as many as ten injections of various substances in the right auricle during the same seance without the slightest inconvenience. Especially abrodil, per-abrodil, tenebryl, thorotrast and collothor have proved in this respect harmless, producing only minimum modifications of the respiratory and circulatory rhythm. If, however, one employs salts in solution it is noted that above a certain concentration a disturbance in the equilibrium of the blood is brought about resulting in precipitation. In case of sodium iodide this occurs when exceeding a concentration of 70 per cent. For this reason the authors believe that sodium iodide should be replaced in arteriography with some other iodine compound or thorium derivative whenever possible. The thorium compounds have the general advantage that they produce no pain when injected, but their rapid diffusion in the blood sometimes leads to roentgenograms of a lesser quality. It must be mentioned that the non-stabilized thorium compounds are extremely dangerous, producing shocks of an extreme gravity and therefore such substances must be absolutely rejected.—*T. Leucutia.*

Leriche, René, Fontaine, René, and Frieh, Ph. Indications et résultats de l'artériographie dans les artérites. (Indications and results of arteriography in arteritis.) *Presse méd.*, July 12, 1933, *41*, 1100-1104.

Arteriography has failed so far to become a practical method in spite of the technical improvements brought about by dos Santos. Especially two inconveniences are responsible for this failure: First, the substances originally used by dos Santos, particularly sodium iodide in a solution of from 25 to 100 per cent, abrodil and uroselectan, cause so much pain immediately after injection that general anesthesia must be used if arteriography is practiced for the upper extremity and spinal anesthesia if practiced for the lower extremity. Secondly, in the original technique dos Santos proposed the systematic denudation of the arteries before injection, this necessitating a true surgical intervention. Following the introduction of thorotrast, however, both the above inconveniences have been eliminated, the thorotrast being entirely painless and its injection through the teguments, due to absence of danger of necrosis of tissue, being feasible. In this manner, arteriography becomes a very simple procedure, necessitating no anesthesia and the actual arterial puncture consuming as little time as in ordinary venous puncture. Furthermore, the method when using thorotrast can be safely applied even in case of deficient circulation.

The authors practiced clinical arteriography in 21 cases of various forms of arteritis, the distribution being as follows: 6 cases of senile arteritis with or without gangrene; 7 cases of diabetic gangrene; 4 cases of Buerger's disease; 3 cases of vasomotor crises simulating Raynaud's disease; 1 case of arterial aneurysm. (1) Senile arteritis. In this form arteriography helps to demonstrate three essential features: (*a*) vascular obliterations; (*b*) parietal lesions of the principal vessels, and (*c*) the state of the collateral circulation. There can be no doubt that any one of these is important from the point of view of surgical indication. (2) Diabetic arteritis. The findings of arteriography here are broadly the same as in senile arteritis, their clinical value assuming a like importance. (3) Buerger's disease. In this form the findings differ from those observed in both the above groups. The segmental limited obliterations here, too, appear to be the rule but the principal vessel and its branches are concentrically diminished in caliber in contradistinction to the senile or diabetic arteries which are usually enlarged and tortuous and have very irregular contours. Likewise, the collateral circulation is greatly diminished, whereas in the senile and diabetic form it is frequently well established. (4) False syndrome of Raynaud. Arteriography is of greatest importance in differentiating this type of lesion. The true Raynaud's disease, as is known, represents a vasoneurosis, characterized by crises of pure vasoconstriction without evidence of arteritis, whereas in the false syndrome the vasomotor crises are the result of beginning arteritis which cannot as yet be demonstrated. In 3 cases the authors were able to detect by means of arteriography localized obliterations which neither the direct examination nor the oscillometer was able to reveal. (5) Arterial aneurysm. In one case of arterial aneurysm of the calf, arteriography demonstrated a sudden arrest at the level of the posterior tibial artery, the aneurysmal sac having been secondarily obstructed by blood clots.

In summarizing, the authors state that it is too soon to give definite conclusions and that further observations are necessary to establish the typical differential criteria of various vascular lesions, but there is no doubt that the method will with time enter the routine practice. Neither the systematic study of the pulse nor the maneuver of Moskowicz nor the oscillometric examination can furnish information on the circulation of the affected limb as valuable as arteriography. The early detection of limited arterial obliterations has made possible in several cases a resection of the blood vessels with great benefit to the patients. A procedure which permits such a conservative treatment merits being known, applied and continued to be studied for its further possibilities.—*T. Leucutia.*

Verbrugge, Jean. La tolérance du tissu osseux vis-à-vis du magnésium metallique. (The tolerance of the osseous tissues toward metallic magnesium.) *Presse méd.*, July 12, 1933, *41*, 1112-1114.

It is a fact long admitted that magnesium when introduced in a bone is absorbed within a few months. This, together with the easy sterilization, solidity, and mechanical appliability, suggested the idea that magnesium plates may be used advantageously in surgery of bone lesions. Unfortunately the first trials have led to such unfavorable effects, especially as concerns the osseous reaction, that the idea was soon thrown into the discard. Lambotte himself, whose pupil the author is, suffered a sad experience twenty-six years ago in a case of fracture of the tibia, where the insertion of magnesium was followed by very severe pain, tumefaction of the extremity, production of gas, and finally elimination of the plate in small pieces within eight days. It is probable that since golded steel screws were used for the fixation of the magnesium plate an electrolytic phenomenon developed which was responsible for the formation of the gas (most likely hydrogen).

The author, in reopening the subject, has performed a series of experiments on rabbits especially on the following points: tolerance of the tissues towards the magnesium metal, degree of osseous reaction, rapidity of resorption of the metal and state of the bone after complete disappearance of the metal. In this article, the results of the experiments as well as the interpretation of the results are presented in detail. The following general conclusions are reached: (1) The magnesium is entirely absorbable from osseous tissue. (2) The absorption occurs at such a rate that sufficient solidity is present during the period necessary for callus formation. (3) The absorption is complete in the animal within a year. (4) There is no evidence of exaggerated or injurious osseous periosteal reaction. (5) The tolerance of the tissues to magnesium appears excellent. (6) There is no evidence of pain.—*T. Leucutia.*

Verbrugge, Jean. Le matériel métallique résorbable en chirurgie osseuse. (Resorbable metallic material in bone surgery.) *Presse méd.*, March 21, 1934, *42*, 460-465.

There are especially two facts justifying the search for a resorbable material in the surgery of fractures: the frequent intolerance of the non-resorbable material and the difficulty in extracting this material at a later date. In spite of the clinical failure of Lambotte twenty-seven years ago and of the unfavorable results of Hey Groves, the author decided to repeat the use of magnesium plates in bone surgery by first performing some experiments on animals and later by trying it in the human. The animal experiments (see above abstract) led to very favorable results. On the basis of these, the method was extended to the human and the author now reports his clinical experience in 21 cases of various fractures. It may be mentioned that the magnesium which was used chiefly in the beginning was later replaced by the Dow metal or electron, which is an alloy of magnesium (92 per cent) and aluminum (8 per cent). The following clinical observations were made:

I. The first fact which attracts the attention of the surgeon after the intervention is the complete absence of pain in the operated region. Generally after the reduction and fixation of a fracture the patient complains of more or less severe pain for at least twenty-four hours, the sensation being not unlike that of a constriction or heavy weight in the region of the fracture. With magnesium there is a sensation of a veritable local anesthesia which starts immediately after the operation.

II. The second day after the operation local heat appears in the operated region which is about one degree higher. This elevation of heat lasts for about two weeks and is probably due

to the chemical reactions which are taking place in the tissues.

III. All patients remained apyretic.

IV. Postoperative roentgenograms revealed the presence of gas. This is most probably due to liberation of free hydrogen from the magnesium carbonate which results from the action of the carbonic acid of the blood on the magnesium. Generally there are three stages in the distribution of the hydrogen around the operated focus: (*a*) Immediately following the operation and during a period which usually corresponds to the period of local heat, the gas appears only in the soft tissues along the bone, chiefly at the places of contact of the metal with the soft tissues. (*b*) After about two weeks the gas disappears from the soft tissues and starts to invade the osseous tissue, giving an osteoporotic, vacuolar or cystic appearance to the bone. (*c*) Still later the gas appears localized around the remnants of the metal as if these were encysted. With progressive absorption of the metal, finally the gas disappears.

V. The process of resorption of the magnesium, although well established in general lines, was not as yet studied in all its details. It seems that this varies from case to case, being a function of the operated region, amount of metal used and perhaps of the individual. It may be said at the present time (*a*) that the metal resorbs slowly enough to permit the production of a good callus and (*b*) that the resorption is complete in less than one year, if not more than 2 to 4 gm. of the metal is used.

VI. The reaction of the various tissues towards the metal seems to prove beyond doubt that magnesium is not toxic and that it is well tolerated: (*a*) The healing of the skin always occurs per primam. In 3 cases a slight yellowish serous discharge was observed from the point of the wound for a brief period due to escape of gas. (*b*) The muscles and the soft tissues apparently remain intact. There is no edema or swelling and no pain. On percussion there is a slight tympanism in the operated region but the presence of a gas pocket could be palpated in only 5 cases. (*c*) The reaction of the bone tissue is practically nil. The formation of the intraosseous callus appears accelerated. (*d*) The behavior of the periosteum is different in the various cases. The majority present the classical periosteal reaction. (*e*) The articulations remain entirely intact, this furnishing the best proof of absence of toxicity or irritation of the metal.

Numerous roentgenograms are used for illustration of the various above-mentioned observations. The general conclusion is reached that the method has great possibilities. The author wishes to emphasize, however, that it should not be used as yet in general practice before the question of safe quantity of the metal is determined on a more rational basis and even then certain precautions should be observed such as simpler operative procedure, quick and efficient maneuvering in the application of the metal, reduction of the time of intervention to a minimum, etc.—*T. Leucutia.*

Shelling, David H., Asher, Dorothy E., and Jackson, Deborah A. Calcium and Phosphorus studies. VII. The effects of variations in dosage of parathormone and of calcium and phosphorus in the diet on the concentrations of calcium and inorganic phosphorus in the serum and on the histology and chemical composition of the bones of rats. *Bull. Johns Hopkins Hosp.*, Dec., 1933, *53*, 348-389.

Authors' Summary.

1. The effects of parathormone on the bones of young rats vary with the dose of the hormone and the calcium and phosphorus content of the diet:

(a) On the stock diet increasing amounts of parathormone up to 10 units daily for a 50-60 gram rat, produce hyperostosis; while 20 units induce osteodystrophia fibrosa.

(b) On rachitogenic diets, parathormone fails to prevent rickets but stimulates osteoblastic activity and trabecular proliferation.

(c) On "border line" rachitogenic diets, parathormone stimulates cartilaginous proliferation as well as increased trabeculation.

(d) On optimal calcium-high phosphorus diets fibrosis occurs with a relatively lower dose of parathormone than on the stock diet.

2. Parathormone injections in the rat evoke moderate hypercalcemia and hyperphosphatemia, the hyperphosphatemia, however, depends on the dose of the hormone and on the phosphorus intake.

(a) On the stock diet, larger doses of parathormone increase the serum inorganic phosphorus nearly 100 per cent, but on the rachitogenic diet, the serum inorganic phosphorus remains at rachitic levels.

(b) In one group of animals fed a low-calcium low-phosphorus diet and injected with 10 units of parathormone daily, the serum calcium was 5.3 and the inorganic phosphorus 14.3

milligrams per cent. In spite of the hypocalcemia and the hyperphosphatemia, there was no clinical evidence of tetany.

3. Analyses of percentages of ash and of calcium and phosphorus of the dry extracted femurs indicate certain dissimilarities between the osseous hypercalcification due to feeding vitamin D and that induced by parathormone. The former increased lime salt deposition in the existing organic matrix so that the ratio of ash to organic matter is increased, whereas parathormone first stimulates trabeculation, and the calcification that follows does not exceed the production of organic matrix, and hence the ratio of ash to organic residue is not increased but may be actually diminished if fibrosis and osteoid tissue are also present.

4. The injection of large doses of parathormone into young suckling rats produces cartilage proliferation, delayed ossification of the epiphyseal centers, decalcification and fibrous replacement of the metaphyses but not typical rickets.

5. Large doses of parathormone produced, in ten day old suckling rats, lesions of the skin resembling scleroderma. These lesions, however, were absent in older rats so treated.

6. Metastatic calcification occurred only when the doses of parathormone were high and when the bones were markedly decalcified.

7. Certain discrepancies in the literature as to the effect of parathormone in the rat are discussed and the divergent results explained as possibly due to variations in (1) age of the animals, (2) dietary calcium and phosphorus and (3) dosage of parathormone.—*R. S. Bromer.*

Vajano, Domenico. Della placentografia e sue possibilità di applicazione clinica. (Placentography and its clinical possibilities.) *Arch. di radiol.*, 1932, *8*, 773-788.

The author describes experiments on guinea pigs and rabbits which show that it is possible to render the placenta visible roentgenographically by means of intravenous or intracardiac injections of thorotrast that are non-toxic and do not injure either mother or fetus and do not interfere with the pregnancy. He thinks it justifiable to conclude therefore that this method can be used clinically in gynecology and obstetrics. It would be particularly valuable in the early diagnosis of extrauterine pregnancy, and for the differential diagnosis of placenta previa, detached placenta, hydatidiform mole and chorio-epithelioma.—*Audrey G. Morgan.*

Angelo, Lorenzi. Sull'associazione delle radiozioni ultraviolette e Röntgen sulla cute. (The association of roentgen and ultraviolet irradiation of the skin.) *Arch. di radiol.*, 1932, *8*, 273-280.

The association of roentgen and ultraviolet rays is generally avoided because it is believed by some workers that they cause an injurious summation of radiant effect. Not all authors agree with this, however. It is important to have the question settled as an association of the two kinds of irradiation is often valuable, for example in bone and gland tuberculosis.

The author therefore performed two groups of experiments. In the one he first gave ultraviolet irradiation and then roentgen irradiation; in the other, first roentgen and then ultraviolet irradiation. Blonde subjects were used in order to avoid pigment interfering with the erythema. The doses used were within the limits of therapeutic dosage. In both groups of cases, no matter which kind of irradiation was used first, and no matter whether the second irradiation was given within a few minutes or not until after fifteen to thirty days, the erythema was more intense on the areas subjected to the two kinds of irradiation than on those subjected to only one. Caution should be used therefore in applying the two kinds of rays to the same subject.—*Audrey G. Morgan.*

Lambranzi, M. Azione dei raggi molli e duri sulla formazione del callo osseo. (Effect of hard and soft rays on the formation of bone callus.) *Arch. di radiol.*, 1933, *9*, 247-250.

The author fractured the hind legs of rabbits and irradiated the fractured zones with hard and soft rays, using moderate doses. Twelve animals were irradiated on the fifth day after the fractures and six were used as controls. After thirty days all the animals were killed and histological examinations made of the callus. In all of the irradiated animals the callus was for the most part osteoid and the metaplasia was more marked and more homogeneous in the rabbits irradiated with hard rays than in those irradiated with soft rays. In the control animals the callus was to a great extent cartilaginous. The blood vessels were also more numerous and larger in the irradiated animals than in the control animals. Hard rays therefore seem to further the development of the callus.—*Audrey G. Morgan.*

Capaldi, Benvebuto. Contributo alla esatta dosimetria mediante un nuovo dispositivo per la misura della distanza tubotumore e per la guida del raggio centrale sui tumori della sfera genitale femminile. (Exact dosimetry by means of a new instrument for the measurement of the distance from tube to tumor and for guiding the central ray to tumors of the female genitalia.) *Arch. di radiol.*, 1933, *9*, 352-360.

The author describes and illustrates a very simple instrument that he has devised for measuring the distance from tube to tumor and for directing the central ray on the tumor in tumors of the female genitalia. It makes it possible to determine by a single application the exact direction that the central ray should take in space to strike the tumor. The exact distance between the skin field and tumor can be read without any complicated calculations or numerical tables. Sounds of different types can readily be attached to it, vaginal, uterine, and rectal, so that it can be used for various localizations of tumor. It can be applied either to the abdominal wall or back.—*Audrey G. Morgan.*

Van Puyevelde, Leo. L'applicazione della radiografia ai quadri. (The application of roentgenography to pictures.) *Arch. di radiol.*, 1933, *9*, 156-166.

This is a discussion of the use of roentgen rays to detect old masters that have been painted over or restored. It is of more interest from the point of view of art than from that of roentgenology.—*Audrey G. Morgan.*

Kirschner, Robert. Einfluss der Radiumbestrahlung auf die Nachkommen von Aphiden. (Influence of radium irradiation on the offspring of aphids.) *Strahlentherapie*, 1933, *46*, 663-674.

Experiments are described in which the effect of radium and roentgen rays on the offspring of plant lice was tested. Tables and curves are given showing the details of the results. It was found that radium irradiation inhibited fertility. This effect was weakest in the first generation and strongest in the second generation of descendants of the irradiated mother animals. Even in the third generation fertility was decreased by about half. Some of the young were still-born, a phenomenon which never occurs ordinarily among plant lice. The largest number of still-born larvae were seen in the second generation.

The experiments showed that small amounts of radium stimulate growth. In all the irradiation experiments, the individuals of the first generation were about a third larger than those of the controls. The individuals of the second and third generations, however, were normal in size. This excludes the theory of a mutation in size as the increased size of the first generation was not transmitted to the second and third generation. The increase in size, therefore, must have been due to a stimulant action of a small amount of radium.

Sexual maturity was also stimulated by the irradiation. While the larval period normally, under the same conditions, lasted from nine to eleven days, the offspring of the irradiated females became sexually mature in six to nine days. The shortening of the larval period was not dependent on the duration of irradiation.

The effect of roentgen rays is very long continued as it extends through three generations. The stimulant factor is weaker than the harmful one for injury is evident in all cases. If the stimulant action were the stronger there would be some cases in which only stimulation was visible, but even when there was stimulation in the first generation, injury was evident in the second generation.

Of course these results cannot be applied to all forms of animals. The boundary line between stimulant and harmful actions varies with the group of animals and with the amount of radium used. The dose of 0.1 milligram, which has a harmful effect on aphids, might have only a stimulant action on mammals. The general biological laws, however, are the same for all groups of animals.—*Audrey G Morgan.*

Wallbach, Günter. Über die Einwirkung von Thorium X auf die Leukozytenkultur des Menschen, mit besonderer Berücksichtigung der entsprechenden Benzolwirkung. (The effect of thorium X on human leucocyte cultures and a comparison between it and the action of benzol.) *Strahlentherapie*, 1933, *46*, 675-696.

The action of thorium X and benzol was tested on cultures of human leucocytes. The experimental conditions differed from those on the living organism as there was no bone marrow to act as a blood-forming organ, and no storage of substances in special organs and tissues, while there was a continuous contact between the benzol and thorium X and the leucocytes.

Thorium X caused a great inhibition of migration and growth of the cells in human leucocyte cultures, and there were also signs of death of the cells in the leucocyte clot. These signs of death were most marked in the granulocytes and only affected the lymphocytes to a limited extent. The effect of thorium X depends to a certain extent on dosage. With low dosage there may be increased migration of lymphocytes and macrophages at first. Granulocytes may even appear in the surrounding medium for the first few days. Fibroblasts are never produced, however, under the action of thorium X. The experimental conditions were such as to show that the action of thorium X is due entirely to its radioactive rays. They also show that the effects of thorium X are essentially the same on cultures of human leucocytes as in the living organism.

The action of thorium X on leucocyte cultures proved to be essentially different from that of benzol, which did not have any visible effect on the growth, migration or differentiation of the cells. This corresponds to the findings in the living organism as benzol did not have any effect on the white blood picture in mice, guinea pigs or fowls. Thorium X decreases the number of leucocytes both in the living organism and in the leucocyte culture, but it is impossible to tell from the experiments whether the destruction of the leucocytes is primarily in the peripheral circulating blood or in the blood-forming organs. The cause of the action on the organism could not be determined in the benzol experiments either.—*Audrey G. Morgan.*

KOGA, Y. Über die Wechselbeziehungen zwischen den Veränderungen des Farbstoffspeicherungsvermögens des Retikuloendothelial-Systems, der Hämobakterizidie und des Mineralstoffgehaltes der Gewebe bei bestrahlten Kaninchen. (Changes in the storage capacity of the reticulo-endothelial system, the bactericidal properties of the blood, and the mineral content of the tissues in irradiated rabbits.) *Strahlentherapie*, 1933, *47*, 201–232.

Experiments are described in which the effect of roentgen irradiation was tested on the storage capacity of the reticulo-endothelial cells, bactericidal properties of the blood and the mineral content of the tissues in rabbits. Tables and curves are given showing the details of the results.

It was found that the capacity of the reticulo-endothelial system for storing carmine was distinctly affected by roentgen irradiation. The curve of storage showed a peculiar wave-like course. On small doses (42 r), storage was increased one hour after irradiation. On irradiation with large doses (120 r) this effect did not occur until after three hours. This is an evidence of the truth of the Arndt-Schultz law, showing the so-called negative phase. The degree of storage of the stain is dependent on the roentgen dosage on individual difference in the sensitiveness of the animals to irradiation and on the time after the irradiation when the tests are made. The disagreements in the reports of previous authors are probably due to the fact that this latter factor was not taken into consideration.

The bactericidal action of the blood was also affected by the irradiation, and these curves also showed a wave-like course. There were three types of change in the bactericidal properties of the blood. The first type was the most sensitive. In the beginning the bactericidal action decreased, then rose, and then continued with a wave-like movement. The second type was the least sensitive. The bactericidal action first rose, then fell, and then continued in a wave-like course. In the third type there was at first no distinct change, but later there was a slight wave-like curve. The negative phase lasted for some time on irradiation with large doses, while on irradiation with small doses there was practically no negative phase. The changes in bactericidal action of the blood were influenced by the same three factors as the storage capacity of the reticulo-endothelial cells.

Both the changes in the storage capacity of the cells and in the bactericidal properties of the blood are evidently dependent on changes in the mineral content of the tissues. The sum of the calcium and potassium contents of the liver and spleen evidently determined storage capacity. The phases of the bactericidal curves do not correspond with those of the storage curves, so that increased storage capacity does not necessarily indicate increase in the other functions of the cells.—*Audrey G. Morgan.*

HORSCH, K. Das neue Kopierverfahren mit Ozaphan. (Copying with ozaphan.) *Fortschr. a. d. geb. d. Röntgenstrahlen*, Jan., 1933, *47*, 82–90.

Ozaphan is the ideal method for copying negatives. It has a medium degree of gradua-

tion and produces a negative with as great sharpness and detail as the original. These copies can be used for further reproduction, for diapositives and for prints.—*E. T. Leddy.*

Wiedmann, G., and Lohmann, Th. Die Abhängigkeit der Intensität von Röntgenspektrallinien von der Röhrenspannung. (The dependence of the intensity of roentgen spectral lines on tube voltage.) *Fortschr. a. d. geb. d. Röntgenstrahlen*, 1933, *47*, 217–219.

The authors investigated potentials up to 85 kv. in which they checked voltage by a sphere gap and made photometric determinations of the intensity of the roentgen spectral lines by a Bragg spectrograph. They used a constant potential generator and a hot cathode tube with a grounded mid point. They found that at first the intensity of the spectral lines increases rapidly with increased voltage according to the formula $I = C(V - V_0)^n$ where I is the intensity, C a constant, V the voltage and V_0 the exciting voltage of the element in question. The value of the exponent n is approximately 2.0. The so-called "turning point" where the intensity deviates from this formula was found to be not 4.5 times the exciting voltage of the particular elements but that between the kv. value of the turning point and the atomic number there is a linear relationship which may be expressed by the formula $kV_w = C \cdot Z$. The constant C for an angle of incidence of 45 degrees is 1.54 and for one of 27 degrees 1.48.—*E. T. Leddy.*

Meller, Oscar. O metodă radiologică pentru stabilirea identităţii unui individ. (A roentgen method for the identification of an individual.) *Bul. Soc. de radiol. si electrol. med. din România*, Oct., 1933, *2*, No. 7, 4–11.

The identification of an individual by means of finger printing sometimes becomes impossible, especially when caustic and exfoliating agents or even surgical grafts have been used for the destruction of the regular skin structure of the fingers. For this reason the elaboration of other methods was attempted by various investigators as a supplementary procedure, chief among them being the study of the conformation of the antrum of the ear, of the umbilicus, etc., but none of these methods could be used satisfactorily. The author pursuing his investigations in the same direction arrived at the conclusion that the roentgen appearance of the frontal sinuses gives images which are precise enough to be utilized for the identification of a certain individual. The technique of examination is not the classical one but the patient is placed in ventral decubitus, the nose occupying the lower one-third of the cassette and the incidence of the ray is directed perpendicularly to the external margins of the orbits. In this manner the errors resulting from the various lengths of the nose as well as from the inclinations of the various types of skulls are obviated.

The images obtained can be classified on the basis of several points: The first character is formed by the principal septum which is noted with S. The septum may be deviated to right (Sd) or to left (Ss) or it may be juxtamedium (Sm). The second character is furnished by the number of semicells forming the superior contour. If, for example, there are 3 semicells on the right and 5 on the left, the formula represented is 3/5. Finally a third character is furnished by the number of incomplete septa of each half of the sinus. If, for example, there is one such septum on the right and 2 on the left, the formula will be 1/2. The totalization of these three characteristics leads to a formula which represents the frontal print of the individual. A group apart is reserved in the classification for the cases with absent frontal sinuses in which the number and size of the ethmoid sinuses are used for the identification. The author tried the method in several members of the same family and in several twins and occasionally a very striking familial similarity was noted, the individual characteristics being still, however, preserved. Finally he examined the frontal sinuses of 16 skulls of celebrated criminals obtained from the Medicolegal Institute of Bucarest. Of these 12 presented unusually large sinuses and of an entirely atypical form. In 3 the sinuses were missing and there was only one normal.

The author recommends that the method be introduced for the identification of an individual. Further experiments will be carried out on the very suggestive results obtained in the case of the criminals.—*T. Leucutia.*

Kögel, G. Über Methoden zur Feststellung der Desmotropie und der Katalyse durch Röntgenstrahlen. (Methods for demonstrating desmotropism and catalysis produced by roentgen rays.) *Fortschr. a. d. geb. d. Röntgenstrahlen*, 1933, *47*, 471–472.

The author has continued some of the experimental methods he has described in this journal

which show that phenols and their derivatives exist in tantomeric form. These forms may be separated by electrophoresis or by the action of roentgen rays on the catalytic surfaces which produces an active compound from the inactive parent substance and the formation of stabile intermediate products by hydration and dehydration by means of iron and activated charcoal.—*E. T. Leddy.*

SAUPE, E., and KLOTZER, FR. Röntgendiagramme von menschlichen Konkrementen. (The roentgen diagrams of human concretions. II.) *Fortschr. a. d. geb. d. Röntgenstrahlen*, 1933, *47*, 352–357.

This is a report on the lattice patterns of some human calculi made with improvements in technique which give clearer and better films than previously. They show that the pattern of an aortic calcification was identical to that of pulverized bone, prostatic calculi, and apatite but unlike that of calcium carbonate and calcium phosphate. Patterns of gallstones and cholesterin agreed and their molecular dimensions may be regarded as about 34 ÅE. The patterns of urinary calculi showed gross crystaline structure and small molecular size (grid constant about 6–8 ÅE). Lohmann, their collaborator, was able to demonstrate roentgen spectrographically iron, copper, manganese and zinc in gallstones.—*E. T. Leddy.*

KALKBRENNER, H., and SCHIEBOLD, E. Die Beugung der Röntgenstrahlen im Dienste der Biologie und Medizin. (The importance of diffraction of roentgen rays in biology and medicine.) *Fortschr. a. d. geb. d. Röntgenstrahlen*, 1933, *47*, 694–703.

The authors point out that roentgen study may bring out fine details of structure in some materials which are obtainable by no other method, and advance histology and pathology by opening up the study of molecular and atomic structure.—*E. T. Leddy.*

HEYDE, W., and SAUPE, E. Untersuchungen über die Arbeitsweise eines Hoch-frequenz-Röntgen-Apparates. (Some investigations of the operation of a high frequency roentgen-ray apparatus.) *Fortschr. a. d. geb. d. Röntgenstrahlen*, 1933, *47*, 323–347.

Heyde and Saupe report some cathode-ray oscillographic studies they carried out on high frequency roentgen machines of du Prel's design. They emphasize that the maximal values of current in the roentgen tube are much higher than previously determined and may even reach thousands of milliamperes. These extremes of current occur simultaneously with the peak voltages which have the same values as the voltage of low frequency machines. They found no extension of the roentgen-ray spectrum to the short wave end. But the short wave range is however excited with a much greater intensity and this fact may explain the superior detail of roentgenograms made at high frequency. Measurements of radiation could not be made entirely free of error because of thermic causes in the spark gap and tube. During measurements of intensity there was a flickering which caused inconstancy of the radiation output. This flickering may be demonstrated on a fluorescent screen and is advanced as one of the greatest practical disadvantages of high frequency apparatus.

They summarize the defects of high frequency roentgen apparatus as follows: (1) The periodic variation of the intensity of radiation (flickering) which is due to the irregularity of high frequency oscillations which produces an irregular action of the spark gap when this becomes hot or burnt rather than due to the actual high frequency radiation itself. (2) The pressure of a large voltage drop relative to the phase due to stresses in the Tesla transformer so that the tube voltage depended to too great an extent on the values of the heating currents which is not so evident in gas free tubes in which only a slight voltage drop is present. (3) The rapid blacking of the high frequency roentgen tubes. This may be due to the practical limitations of high frequency tubes which up to the present have been designed only for small peak current values. But the results which have now been obtained suggest that these difficulties may be overcome.

The advantages of the apparatus are its lightness and transportability, that it can be connected directly to the electrical mains, the almost complete protection against high tension shock, its single operation and the improved value of the roentgenograms it produces. The authors feel that such apparatus should be able to supplant much of the low frequency apparatus used for bedside roentgenography.—*E. T. Leddy.*